MARYLAND TRANSIT ADMINISTRATION

MARYLAND DEPARTMENT OF TRANSPORTATION
Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
James T. Smith, Jr., Secretary • Robert L. Smith, Administrator

TO: All Planholders

FROM: Maryland Transit Administration

SUBJECT: **ADDENDUM NO. 3**
Contract No.: T-0451-0240
NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM

DATE: October 21, 2013

Enclosed and effective this date is Addendum No.3 to the subject Contract. This change does extend the Bid Opening Date of October 23, 2013 to November 7, 2013. Also, a copy of all the revisions has been included with this Addendum No.3.

The Bidder shall acknowledge receipt of this Addendum by completing and returning this form with the bid package.

All other terms and conditions remain unchanged.

Sincerely,

Joseph B Johnson
Joseph B Johnson, Procurement Officer
Professional Services/Construction/Installation Section
Procurement Division

Acknowledgement of receipt of ADDENDUM # 3 to Solicitation #T-0451-0240

Vendor Name: _____

_____ _____
Authorized Representative's Signature Date

ADDENDUM NO.: 3
DATE: 10/21/13
CONTRACT NO.: T-0451-0240

The following additions, deletions, and modifications are hereby made a part of the Contract Documents of NORTH AVENUE ROUTE PUSHBUTTON SYSTEM, Contract No.: T-0451-0240.

Item No.	Page	Modification
I. QUESTION & ANSWERS		
	Pg. 1 of 6	**See Attachment**
II. CONTRACT SPECIFICATIONS		
1	Notice to Contractor (NTC) Pg. 1 of 6	***Bid Due Date changed to November 7, 2013***
2	Notice to Contractor (NTC) Pg. 1of 6	Revised- MBE Percentage Goals to reflect 7% African American; 4% Asian American and 1% to be used at the bidder's own discretion for the 12% MBE requirement.
3	BF 4 of 8	Item 14 – Wheel Detectors: Quantity changed from 30 to 31
4	Buy America Certificate_ Steel	Revised - Buy American Steel; form titled **Steel, Iron or Manufactured Products** with be used for this contract
III. SPECIAL PROVISIONS		
1	01110 - p21	The section titles "PLANS, SCHEDULES, REVIEWS, DOCUMENTATION, WARRANTY, TRAININY, ETC" was not numbered. It is now numbered 1.13 and all subsequent section numbers have increased by one.
2	01110-1.13 (new section number per item 1 above)	In the Project Milestones table, the intent of the 5th and 6th items has been clarified and a new 9th item has been added to identify when all Operations and Maintenance training should be complete.
3	01110-1.13 (new section number per item 1 above) B.2	The due date for the Project Migration Plan has been clarified/changed to twenty one (21) days after NTP for consistency with the requirement in 01300-1.02.C.1.
4	16135-2.01, 2.02, 2.03	Identified sections 2.01, 2.02 and 2.03 as not applicable to this contract. Handholes for this contract shall be in accordance with 16135-2.04 and 16050-2.12.
5	16050-3.01	Added new clause 3.01 to identify new conduits to be installed between hand boxes and all wheel detectors and pushbuttons
6	17139-1.03	Revised clauses D and E to clarify interfaces between new and existing cable trough and interfaces between all cable trough and hand boxes.

7	17142-2.01	Previous clause 2.01.H.1 renumbered to 2.01.I and revised to clarify that the wheel detector reset function should be available at any time and not only following a restoration of power.
8	17175-4.01.B	Bid Item reference changed from "009" to "016"
9	17175-2.01.B	Panel type has been clarified as "LED" instead of "LCD plasma"
10	01110-1.09.A.8.b	Clarified that the contract drawings will be made available to the Contractor in Autocad format
IV. CONTRACT DRAWINGS		
1	Drawing GI-01 Sheet 2 of 44	Drawing number for Sheet 7 changed from SG-37 to SG-39
2	Drawing SG-37 Sheet 7 of 44	1. Drawing number changed from SG-37 to SG-39. 2. For South direction Route "T5S to MOW" "From" column changed from "P9 or P9A" to "P9" i.e. this route is not required on the P9A pushbutton.
3	Drawing SG-04 Sheet 9 of 44	1. Additional clarification added to identify all new cable trough as Model 68. 2. WD7A removed and WD7B added
4	Drawing SG-05 Sheet 10 of 44	1. Conduits for P29 and WD27 redrawn to show them in a common trench under track T3. 2. WD7A added 3. Location of WD7 changed
5	Drawing SG-16 Sheet 23 of 44	1. Cable "FOC to North CIH" removed. See also change on SG 33 below. 2. Cable for WD7B added 3. WD7A location changed 4. WD7B added 5. Note 3 added
6	Drawing SG-21 Sheet 28 of 44	1. Racks revised to identify all racks as new (i.e. to be supplied by the Contractor) 2. Added Note "Contractor shall supply similar racks as necessary for the North CIH and wall attachments as necessary for all CIHs."
7	Drawing SG-22 Sheet 29 of 44	Added Note "Similar for North CIH"
8	Drawing SG-23 Sheet 30 of 44	Added Note "Similar for North CIH"
9	Drawing SG-26 Sheet 33 of 44	Cable "FOC to South CIH" changed to "FOC to OCC". This change and the one above for SG-16 place the OCC in the same FOC ring that connects the CIHs as shown on SG-01 Sheet 4 of 44 rather than a separate connection.
10	Drawing SG-33 Sheet 40 of 44	Material item 18 changed from '2" Conduit' to '3" Conduit'

11	Drawing SG-36 Sheet 44 of 44	Added Note 8 "Wheel detector shall not detect the lead axle when cab window is aligned with pushbutton as shown."
12	Drawing SG-38 Sheet 8 of 44	For North direction Route "MOW to T5S" "To" column changed from "P9 or P9A" to "P9".
13	Reference Drawing Sheets 1 to 3	Added 3 reference drawings displaying FOC (fiber optic cable) run distances to the equipment room in the shop building.
14		**Please be advised that there are revised drawings associated with responses to some of the vendors questions, and a copy of the drawings can be obtained by e-mail request via e-mail to: jjohnson14@mta.maryland.gov**

All other conditions of this IFB remain the same.
Also attached are the answers to contractors' questions.

NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM
CONTRACT NO. T-0451-0240
7-Oct-13

#	Ref.	QUESTIONS	RESPONSES
1	General	Plans are detailed for a specific type of PLC hardware. Please advise the source of the hardware that was used in the development by AECOM.	Plans are not specific to a particular type of PLC hardware.
2	General	Plans are detailed for a specific type of Wheel Detector hardware. Please advise the source of the hardware that was used in the development by AECOM.	Plans are not specific to a particular wheel detector supplier.
3	01110-1.08.A.2 17175	Please define the display for the MTSP screens required at North and South yard. Are multiple Push Button icons required at each entrance point in the track diagram corresponding to maximum number of exit points? Where a particular PB entrance location has 11 possible exit points then for that track segment we would have 11 PB icons stacked?	Contractor may use either: 1) A single pushbutton icon at each route entrance which initiates a drop down menu that presents all the routes available from that location – one menu item to represent each route that is available from each location plus a common "cancel" item. 2) A single pushbutton icon at each location in combination with entrance/exit logic. With this approach, the user would first select the desired entrance (start of route) location and the panel will identify by indications all of the possible exit (route destination) locations. The user would then select the desired exit location and the PLC logic will use the selected entrance and exit locations to establish the desired route. With this approach, each icon would initiate a drop down menu with just "select" or "cancel".
4	01110-1.08	Field Push Button operation 01110-11, 1.08 states lights are normally dark and once a selection is made the lamp begins to flash. If a switch is unable to move to the required position (obstruction) the result is also a flash. How are the two states differentiated and communicated to the train operator so if the later is present he knows to cancel and possibly select another route?	The system only differentiates between the two conditions by the duration – if everything is working correctly, the indicator will flash while the track switches are in transition and then change to a solid indication whereas if a track switch is obstructed the indicator will continue to flash.
5	SG-32	Please define the operation of Field PB routes using P9 and P9A. Route sheets use 9A or 9 in the southbound routing to all exit tracks. Is the 9A PB box to be used for southbound and northbound moves? Can the 9A PB be used to clear directly to P10 or any other exit without pushing P9? Are key switches required for both P9 and P9A?	P9A is for southbound routes only and performs exactly the same functions as P9 except that a means to select the route into the storage track is not required (see Note 1 on Drawing SG-32). Track 5 is the car wash track. P9A is provided to allow a train to select the southbound exit route from the car wash before it enters the car wash at the north end of the building (the alternative is that the train would have to stop at the south end of the car wash to select the exit route and this interferes with the correct operation of the car wash). A train on Track 5 at the north end of the building wishing to proceed to the north tail track will use P27 to select the northbound route.

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#	Ref.	QUESTIONS	RESPONSES
6	01110-p20	Please clarify Project Milestones 01110-20, item 5, Training Program. Should this milestone state Training Program Plan and not the actual written training manuals? Also when should the actual Training take place. Operating documentation and an operational system are required for a meaningful Training Program. The Training Program (actual classroom and hands-on training) should be scheduled after the milestones: Operating Documentation (as operating and maintenance manuals are required for the Training Program, see 01301-6, A) and also after FAT but sufficiently before the completion of the FAIT. The Training Program can only begin after approval of the Training Plan (01301-9, I). Please comment on our assumptions.	MTA's goal is to have the route pushbutton system placed into service immediately following FIAT. Consequently, all training must be completed and all operations and maintenance manuals submitted prior to completion of the FIAT. The "Training Program" requirement for 120 days after NTP includes the Training Program Plan and all identified trainer and trainee documents – submitted for MTA review and comment, not the multiple copies required for actual training. Operations and Maintenance manuals (again, submitted for MTA review and comment, not the multiple copies required for record) should be submitted by NTP plus 210 days in accordance with Item 6 – Operating Documentation. Final copies of Training Documents and all Operations and Maintenance Manuals should be available for the start of actual training. Actual training should be completed by NTP plus 360 days.
7	17171 SG-21	Plans are detailed for a specific type of NV relay and mounting plate. Please advise the source of the hardware that was used in the development by AECOM.	Plans are not detailed for a specific type of NV relay.
8	01110-p21.B	In section "PLANS, SCHEDULES, REVIEWS, DOCUMENTATION, WARRANTY, TRAINING, ETC." Sub Section B "PROJECT MIGRATION PLAN AND PROJECT SCHEDULE" Item 2 states "Within thirty (10) days after receipt by the contractor of the Notice to Proceed, the Contractor shall deliver the Project Migration Plan and Project Baseline Schedule.". Is the duration to be thirty (30) days or ten (10) days after NTP?	Requirement will be revised to "twenty one (21) days" to be consistent with the requirement in 01300-1.02.C.1
9	01110- 1.09.A.4.e	The specification states: "The redundant PLC shall be powered from three independent power supplies; one for the normal PLC, one for the stand-by PLC and one for the I/O modules.". The drawings don't show a separate power supply for 94 CIH and North CIH. Please confirm that the Contractor should use existing power supplies for 94 CIH and North CIH.	Please refer to 01110-1.09.A.6

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#	Ref.	QUESTIONS	RESPONSES
10	01110-1.05.C	The specifications state: "As an additional option, the Contractor shall provide Zone 5 thru 13 for the north tail track and storage tracks between the North and South portions of the yard. These zones shall utilize the same wheel detectors as used for Zones 1 thru 4.". Please confirm the Contractor is not to provide any additional wheel detectors for the option work and the Contractor will utilize the wheel detectors being provided as part of the base contract to complete the option work.	The expectation is that the wheel detectors required for Zones 1 thru 4 at each end of each storage track and at the south end of the north tail track will be interfaced to additional zone controller modules for Zones 5 thru 13.
11	SG-21	South CIH shows wheel detector controller modules. However, the quantities shown do not reflect the total quantities required for the project. Are the remaining wheel detector control modules to be installed in North CIH and/or 94 CIH? If yes, please modify the 94 CIH and North CIH drawings to reflect this.	Drawing SG-21 shows three WD Controller modules which are intended to be for Zones 1, 2 and 3. The wheel detector controller module for Zone 4 should be installed in the North CIH. It is not anticipated that any WD controller modules will be installed in 94 CIH. Bidders shall make their own determination as to whether the WD Controller modules for option Zones 5 thru 13 should be located in the North CIH or the South CIH.
12	SG-21	Drawing SG-21 shown new equipment to be mounted on three racks. Is the Contractor required to provide these racks or are they already present in the South CIH.	Racks are not existing. Contractor shall provide racks as shown for the South CIH. If Contractor's equipment will not all fit on the three racks shown, Contractor shall provide additional racks as necessary. Contractor shall also provide all required racks in the North CIH and all required wall attachments in all CIHs.
13	NTC-12.C	The specification states that the goal for Minority Business Enterprise participation is "**12%**". Please confirm there are no MBE requirements.	The MBErquirements set for the contract is 7% African American; 4% Asian American which leaves 1% to be used at the bidders discretion.
14	SG-04, 31 16050-2.12 16135-2.01	Can MTA clarify if the Hand Holes shown on Drawing SG-04 are intended to be as described in Spec Section 16135 or as described in Spec Section 16050-2.12	Handholes as shown on SG-04, SG-05 and SG06 shall all be in accordance with 16050-2.12.
15	SG-05	Wheel Detector #7 is shown being located in the concrete apron of the Yard Shop Building. Though the concrete could be sawed cut and patched for installation, maintenance or replacement would be difficult. Can other locations be considered for this area?	WD7 must be located north of the point of switch for switch 17B and with sufficient clearance to ensure that the train is clear of the point of switch when the wheel detector senses the presence of the first/last axle.
16	SG-04	Wheel Detector #7A is shown being located in the asphalt pathway surrounded by heavy timbers. Though the asphalt could be saw cut and patched for installation, maintenance or replacement would be difficult. Can a section of the heavy timbers be removed for the installation of this wheel detector? Can other locations be considered for this area?	After further consideration, it has been determined that there is no single location for WD7A that can detect clearance for both Zones 1 and 2. Consequently, we are adding an additional wheel detector WD7B. WD7A will be used as the boundary for Zone 1 and WD7B will be used as the boundary for Zone 2. The added benefit is that WD7A and WD7B can both be located outside of the paved roadway.

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#	Ref.	QUESTIONS	RESPONSES
17	SG-05	Can the raceway for P27 and WD27 that crosses under the track be run through the ballast or does it need to be trenched deeper under the tracks?	All conduits that cross tracks shall be trenched in accordance with 16135-3.03.G. Conduits for P29 and WD27 may be routed through a common trench.
18	SG-01 SG-16 SG-26	Drawings SG-16 and SG-26 show the Fiber Loop (Ring) going between the 94 CIH, South CIH and North CIH with a tail from the South CIH going to the yard OCC. Drawing SG-01 shows the Yard OCC as part of the Fiber Loop (Ring). Which is correct?	SG-01 is correct. The LRC network connection should be included in the fiber loop.
19	SG-21 SG-22	On Drawing SG-21 Rack 1, Rack 2 and rack 3 appear to be drawn as existing but on drawing SG-22 these same racks appear to be new. Do these racks exist?	Racks are not existing. Contractor shall provide racks as shown for the South CIH. If Contractor's equipment will not all fit on the three racks shown, Contractor shall provide additional racks as necessary. Contractor shall also provide all required racks in the North CIH and any additional required racks in 94 CIH.
20	17175-4.01.B	Under measurement and Payment of Spec Section 17175 it states to include the maintenance Touch Screen Panel with Bid Item 009. Bid Item 009 is 3" Schedule 80 buried conduit. Is this the correct Bid Item for the Maintenance Touch Screen Panel?	The correct reference should be Bid Item 16 (note that the Measurement section in Section 17195 includes the work required by section 17175).
21	SG-21 SG-22 SG-23	The North CIH appears to missing the typical drawings comparable to SG-21, 22 and 23, of the South CIH. How are we to assess the North CIH similar efforts?	The floor plan of the North CIH is essentially the same as that provided for the South CIH. It has the same existing cable tray arrangement and the same lack of existing racks in the center of the bungalow. There is also equivalent space on the C wall to mount the maintenance panel.
22	General	Will MTA make available As-built drawings for the South and North CIHs to support identifying the existing equipment layouts and interface wiring?	MTA will make existing as built drawings available to the successful bidder. MTA will expect existing drawings to be modified where appropriate and new drawings to be integrated with the existing drawing sets. If desired, bidders may inspect these existing drawings at MTA's headquarters but they will not be distributed to bidders due to sensitive security information (SSI) concerns.
23	SG-21 SG-22	Drawing SG-21, it implies that there are existing empty racks in place at the South CIH. However, in SG-22, the racks are depicted as new. Please clarify.	Racks are not existing. Contractor shall provide racks as shown for the South CIH. If Contractor's equipment will not all fit on the three racks shown, Contractor shall provide additional racks as necessary. Contractor shall also provide all required racks in the North CIH and any additional required racks in 94 CIH.

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#	Ref.	QUESTIONS	RESPONSES
24	01500-	In Special Provisions, Spec Section 1150, Contractor is tasked with furnishing flagmen or watchmen. Please specify the requirements of flagmen and any special training that would be required to fulfill this role.	MTA's Railroad Worker Protection rules require all workers working within 10 ft of the centerline of track to take a one day Track Access Course. In addition, each work crew must be supervised by an On-Site Coordinator and protected by appropriate flagmen or watchmen. The course for On-Site Coordinators and Flagmen/Watchmen is one day in addition to the Track Access course. There is no charge to the Contractor for the courses, but the labor cost (time) is at the Contractor's expense.
25	01150-	Please provide general work hours or shift times for this project.	Because the work is located entirely within the confines of the North Avenue Yard, normal daytime work shifts are anticipated (the yard is actually busier at night than during the day so permission to work at night will be more difficult). However, during certain periods of the day, there are significant train movements through the South end of the yard which connects to the mainline. During these periods the Contractor may find it more efficient to work at the North end of the yard to avoid the constant work interruptions to permit trains to pass.
26	SG-04 SG-33	In SG-04, conduit from wayside equipment to cable duct hand hole is depicted as 3" PVC, Schedule 80. In SG-33, the conduit is listed as '2" Conduit'. Please clarify the conduit requirements.	Conduits shall be 3" and will be paid for under Bid Item 009.
27	SG-04	In SG-04, new cable trough is not labeled clearly by model type. Is all new cable trough to be Model 68?	Yes
28	General	Will MTA be listed as the Generator on the manifest in the case of disposal of materials that are deemed hazardous?	Yes.
29	General	The Scope of Work includes Design. However, there are no provisions discussing payment for Design, and the Bid Form does not include a line item for Design. Through which avenue can payment for Design be executed?	Costs for Design should be included in Bid Items 9, 11, 12, 13, 14, 15, 16 and 18 as appropriate.
30	CQ-11(k)	In Contractor's Questionnaire, Question 11(k) asks if any directors, etc. have been found guilty of a crime related to the business. Is the question directed towards only current directors?	Yes.

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#	Ref.	QUESTIONS	RESPONSES
31	SGP-4.03	In SGP-4.03, it states that the cost of Change Orders not performed on force account will be based upon the documented costs allowed by the contract in the rest of the clause. As it is not possible to have documented costs before start of work, MEC can interpret this to mean that a Change Order will not be issued before the work is performed. Please clarify if this means that Change orders will in effect always be work performed on force account.	SGP-4.03 provides a framework for negotiation - cost proposals are expected to show full details of labor, material and equipment unit prices and quantities and associated overheads. "Documentation" may be in the form of established labor rates, material prices from vendors, standard equipment rates, material quantity estimates based on the required scope of work, man-hour estimates based on the required scope of work etc. Cost estimates for changed work can be submitted and negotiated with MTA based on these unit prices and estimated quantities. This process allows negotiations to proceed as soon as the Contractor has submitted a cost proposal and does not require all additional work to be performed on a force account basis.

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION
NOTICE TO CONTRACTORS

CONTRACT TITLE: NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM

CONTRACT NO.: T-0451-0240 **DATE:** September 9, 2013

1. DESCRIPTION OF WORK

A. This project is for the design, furnish, test and place in service a pushbutton routing system at the Light Rail North Avenue Yard.

B. Estimated value for this work is in the range of $2,500,001 to $5,000,000

2. PRE-BID MEETING & SITE VISIT

A Pre-Bid meeting for the purpose of explaining the Project will be held on **September 19, 2013 at 10:30 a.m.,** local time at the Administration Headquarters, 6 St. Paul Street, 7th Floor Conference Rooms 731-732, Baltimore, Maryland 21202-1614.

A Site Visit will be held on **September 19, 2013** immediately following the Pre-Bid Meeting. **OR** The site is accessible to the public and bidders can visit on their own.

It is strongly suggested that the person(s) responsible for the preparation of bid documents for bidders attend the Pre-Bid Meeting and the site visit. INSTRUCTIONS CRITICAL TO THE PREPARATION OF THE CONTRACT DOCUMENTS WILL BE PRESENTED AT THE PRE-BID MEETING.

3. DEADLINE FOR QUESTIONS

Questions regarding the work should be directed in writing to Mr. Joseph Johnson at the Administration Offices or via Internet address jjohnson14@mta.maryland.gov. No facsimile messages will be accepted unless accompanied by telephone notification at (410) 767-3363. Our fax number is (410) 333-4810. Questions directed to this office must be received no later than **October 2, 2013** at the close of the business day. Questions should be submitted on company letterhead. No interpretations other than written shall be binding on the Administration.

4. DUE DATE & TIME

Sealed Bids addressed to the Maryland Transit Administration, Contract Administration Department, 6 St. Paul Street, 7th Floor, Baltimore, Maryland

21202-6806, and marked "Bid for Contract No. T-0451-0240", will be received at the above address until but not after 2:00 P.M. local time **November 7, 2013**. At that time, the Bids will be publicly opened and read aloud at a location at the same address. Hand delivered bids should be deposited in the Bid Box located on the 7th Floor before the 2:00 P.M. deadline.

Any bids received after the date and time specified shall not be considered.

5. ELECTRONIC VERSION OF BID DOCUMENTS

The bid documents will be available by electronic means. The Bidder acknowledges and accepts full responsibility to ensure that the Bidder has made no changes to the Administration's bid documents. In the event of a conflict between the version of the bid documents in the bidder's possession and the version maintained by the Procurement Officer, the version maintained by the Procurement Officer shall govern.

6. AVAILABILITY OF DOCUMENTS

Specifications may be downloaded from the MTA web site located at www.mta.maryland.gov. Bidders will be required to log in the first time specifications are downloaded. This number should be used every time the bidder downloads the documents for this contract. Bidders must supply accurate information in order to receive notice of all subsequent addenda.

To obtain the specifications: Click on "Business", then "Procurement", then "Bids/Solicitation". All projects that are currently advertised will appear at the bottom of the page. You may then choose to download the specifications.

To obtain the drawings: Notify the MTA at jjohnson14@mta.maryland.gov submitting your company name, a contact person, a mailing address (not P.O. Box) and a phone number. A CD containing the drawings will be mailed after verification of the contractor information.

7. ADDENDA

Bidders are required to acknowledge all addenda with their bid package.

Although the MTA endeavors to send out all addenda to this solicitation in a timely manner, it is the responsibility of the contractors to make sure they received all appropriate documents prior to the bid due date.

8. EMARYLAND MARKETPLACE REGULATIONS

"e-Maryland Marketplace" is an electronic commerce system administered by the Maryland Department of General Services.

This means that all such information is immediately available to subscribers to e-Maryland Marketplace. Because of the instant access afforded by e-Maryland Marketplace, it is recommended that all Bidders interested in doing business with Maryland State agencies subscribe to e-Maryland Marketplace.

9. BID BOND

Each bid exceeding $100,000 must be accompanied by a Bid Bond in the amount of five percent (5%) of the Bid Price. Bid, payment, and performance security may be in the form of: (1) a bond executed by a surety company authorized to do business in the State; (2) a bond executed by an individual surety that meets certain criteria; (3) another form of security required by State or federal law; or (4) another form of security satisfactory to the unit awarding the contract. Sections 13-207, 13-216, 17-104 of the State Finance and Procurement Article, Annotated Code of Maryland.

10. PAYMENT AND PERFORMANCE BONDS

Payment and Performance Bonds in the amount of the Contract Price will be required by the awardee. Upon receiving notification of contract award, the Contractor shall deliver the bond to the MTA no later than the time the Contractor executes the contract. Bid, payment, and performance security may be in the form of: (1) a bond executed by a surety company authorized to do business in the State; (2) a bond executed by an individual surety that meets certain criteria; (3) another form of security required by State or federal law; or (4) another form of security satisfactory to the unit awarding the contract. Sections 13-207, 13-216, 17-104 of the State Finance and Procurement Article, Annotated Code of Maryland.

11. ELECTRONIC FUNDS TRANSFER

On every solicitation for a contract expected to exceed $200,000, the bidder will be required to accept payments by electronic funds transfer (EFT) unless the State Comptroller's Office grants an exemption.

12. MINORITY BUSINESS ENTERPRISE PROGRAM

A. **MINORITY BUSINESS ENTERPRISES ARE ENCOURAGED TO RESPOND TO THIS SOLICITATION NOTICE.**

B. The Maryland Transit Administration hereby notifies all bidders that, in regard to any Contract entered into pursuant to this advertisement, Minority

Business Enterprises will be afforded full opportunity to submit Bids in response to this Notice, and will not be subjected to discrimination on the basis of political or religious opinion or affiliation, race color, creed, sex, age or national origin in consideration for an award.

C. It is the goal of the Administration that Minority Business Enterprises participate in all Contracts. Each Contract will contain goals for Minority Business Enterprise participation on a contract-to-contract basis. A subcontracting goal of **twelve** percent **12%** of the total contract dollar amount has been established for this procurement. This dollar amount includes a sub goal of **seven** percent **7%** of the total contract dollar amount to be allocated to certified minority business enterprises classified as **Asian American**-owned businesses, and a sub goal of **four** percent **4%** of the total contract dollar amount to be allocated to certified minority business enterprises classified as African American-owned businesses. All bidders must submit with their bid a fully executed copy of the Certified MBE Utilization and Fair Solicitation Affidavit (MDOT MBE FORM A and MBE Participation Schedule (MDOT MBE FORM B). If the bidder fails to submit these completed forms with the bid as required, the procurement officer shall deem the bid non-responsive or shall determine that the offer is not reasonably susceptible of being selected for award. ALL MBE FIRMS MUST BE CERTIFIED BY THE MARYLAND DEPARTMENT OF TRANSPORTATION. NO OTHER CERTIFICATIONS WILL BE ACCEPTED.

D. **A contractor may count toward its MBE goal 60 percent of its expenditures for materials and supplies required under the contract and obtained from a MBE regular dealer, and 100 percent of such expenditures to a MBE manufacturer. The MBE credited supplies may not exceed 60 percent of the entire contract goal.**

E. New versions of Sections 13-103, 13-104 and 14-303 of the State Finance and Procurement Article of the Maryland Code, relating to increased bid/proposal documentation of MBE commitments, are effective as of October 1, 2004. The Contract under this solicitation will be awarded in accordance with these new requirements. As a result, new bid submission requirements, including certain revised MBE documents, are in effect for this solicitation. These new requirements are set forth elsewhere in this solicitation.

F. As a result of the revisions to Sections 13-103, 13-104 and 14-303, certain existing portions of the Code of Maryland Regulations (COMAR) relating to post bid submission of MBE subcontractors are inconsistent with the revised statute. To the extent the provisions of COMAR relating to post bid identification of MBE subcontractors are inconsistent with the requirements of this solicitation, the requirements of this solicitation shall control the award of a Contract. Questions or concerns regarding the MBE requirements

of this solicitation must be raised prior to the opening of bids or receipt of initial proposals

13. AFFIRMATIVE ACTION REQUIREMENTS

Bidders on this Work will be required to comply with MTA Affirmative Action Requirements and all applicable Equal Employment Opportunity Laws and Regulations.

14. FUNDING

This contract is funded with 100% state funds.

15. SUSPENSION AND DEBARRMENT CERTIFICATION

All bidders will be required to certify that they are not on the GSA List of Parties Excluded from Procurement and the List of Contractors Suspended or Debarred from Contracting with the State of Maryland. All bidders must also be in good standing with the State Assessment & Taxation Department.

16. CONTRACTOR'S QUESTIONNAIRE

All Bidders shall submit a fully executed copy the Contractor's Questionnaire Pre Award Evaluation Data Form with the bid package.

17. INSURANCE REQUIREMENTS

The Administration has chosen to provide Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective coverage on behalf of Contractors and subcontractors working on this project. This approach to project insurance is commonly called a wrap-up or owner controlled insurance program (OCIP). Specific information regarding Liability Insurance Requirements is contained in the Contract Specifications.

Please note that an Insurance Cost Worksheet must be included with each bid package.

18. USE OF BIDDER'S OWN FORCES

The bidder with his own forces shall perform not less than Fifty (50%) of the work at the project site.

19. BUY AMERICA REQUIREMENTS

This contract is subject to Section 165, "Buy America", of the Surface Transportation Assistant Act of 1982, U.S. Public Law 197-424, and regulations and/or guidance implementing this statutory provision issued by the Federal

Transit Administration of the U.S. Department of Transportation. The contract is further subject to the Buy American Steel requirements of Chapter 02 of subtitle 11 of the Code of Maryland Regulations, Title 21, State Procurement Regulations.

20. INVESTMENT ACTIVITIES IN IRAN ACT

State Finance & Procurement, §§17-701 – 17-707, Annotated Code of Maryland [Chapter 447, Laws of 2012].

> A company listed on the Investment Activities In Iran list is ineligible to bid on, submit a proposal for, or renew a contract for goods and services with a State agency or any public body of the State. Also ineligible are any parent, successor, subunit, direct or indirect subsidiary of, or any entity under common ownership or control of, any listed company.
>
> Agencies must obtain a certification regarding investments in Iran from each bidder or offeror for new contracts and from each contractor seeking to renew an existing contract. Specifically, bidders, offerors, and renewing contractors have to certify that at the time the bid/proposal is submitted or the contract renewed that the company is neither identified on the Investment Activities In Iran list nor engaging in investment activities in Iran.
>
> A company that cannot make the certification must supply the agency, under penalty of perjury, with a detailed written description of its investment activities in Iran.

False Certifications: If an agency, using credible information, determines that a company has submitted a false certification regarding its investments in Iran, the agency must notify the company and provide the company 90 days to demonstrate in writing that it is not engaged in investment activities in Iran. If the company fails to demonstrate that it is not engaged in investment activities in Iran in that time, the agency shall report the company to the Attorney General and to the Board of Public Works.

21. CANCELLATION OR REJECTION OF BIDS

Notice to Contractors may be canceled in accordance with State Procurement Regulations.

The Administration reserves the right to reject any and all bids and/or waive technical defects if, in its judgment, the interests of the Administration so require.

STATE OF MARYLAND
MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
001	01110	Support During Initial Yard Operations	40	HRS	$	$
002	01110	Software Upgrades	120	HRS	$	$
003	01130	Mobilization	1	LS	$160,000.00	$160,000.00
004	01210	Miscellaneous Work Allowance	1	Allowance	$208,590.00	$208,590.00
005	01301	Operations and Maintenance Manual	1	LS	$	$
006	01301	Training	1	LS	$	$
007	01450	Quality Assurance and Quality Control	1	Allowance	$60,755.00	$60,755.00
008	01523	Engineer's Field Office	1	Allowance	$20,000.00	$20,000.00
009	16135	Buried Conduit - 3" Schedule 80 PVC	550	FT	$	$
010	16790	Spare Parts and Special Test Equipment	1	Allowance	$80,000.00	$80,000.00
011	17123	New Pushbutton Assemblies	28	EA	$	$
012	17123	Replacement Pushbutton Components	1	LS	$	$
013	17139	Cable Trough	300	Ft	$	$
014	**17142**	**Rail Mounted Wheel Detectors**	**31**	**EA**	**$**	**$**
015	17142	Wheel Detector Controllers and Output Relays	4	EA	$	$
016	17195	Microprocessor Interlocking System	1	LS	$	$
017	17251	Testing and Inspection	1	LS	$	$

Award of Contract is based upon the Total Amount Bid For Item Numbers 001 Through 017 inclusive: $_____

(Figures)

_____

_____

(Words)

Item	Section	Description	Estimate of Quantity	Unit	Unit Price	Total Price
018	01110	Option 1 Wheel Detector Zones for North Yard Tail Track and Storage Tracks	1	LS	$	$

Total Amount Bid for Option 1: $ _____

(Figures)

_____

(Words)

The Bid Price for Option 1 shall be valid for the period up to 60 days after NTP.

Item	Description	Quantity	Unit	Unit Price	Total Price
019	Insurance Premium (Contingency)	1	LS	$	$

This amount will only be added to the base bid in the event that the bidder is excluded from the wrap-up insurance program or the program is terminated mid-term. The Insurance Premium Worksheet must be attached to the bid.

STATE OF MARYLAND
DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION

As a condition of responsiveness, the bidder or offeror must submit with his bid a completed Certificate of Compliance OR a Certificate of Non-Compliance.

STEEL, IRON OR MANUFACTURED PRODUCTS

CERTIFICATE OF COMPLIANCE WITH 49 U.S.C. 5323 (j)(l)

The bidder hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(l) and the applicable regulations in 49 C.F.R. Part 661.5.

DATE _____

SIGNATURE _____

COMPANY NAME _____

TITLE _____

-OR-

CERTIFICATE FOR NON-COMPLIANCE WITH 49 U.S.C. 5323 (j)(l)

The bidder hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j)(l) and 49 C.F.R. 661.5, but it may qualify for an exception pursuant to 49 U.S.C. 5323(j)(2)(A), 5323(j)(2)(B), or 5323(j)(2)(D), and 49 C.F.R. 661.7.

DATE _____

SIGNATURE _____

COMPANY NAME _____

TITLE _____

SECTION 01110

SUMMARY OF WORK

PART 1: GENERAL

1.01 DESCRIPTION:

A. The Central Light Rail North Avenue Yard is currently equipped with electrically powered switch machines that are activated by wayside pushbuttons adjacent to each switch machine. This requires the train operators to stop their trains at each switch and leave the train to operate the switch to the required position. To improve efficiency and personnel safety, MTA is going to add route pushbuttons that will set all switches in a route. The functions of the route pushbuttons will be controlled by a redundant non-vital PLC. To further enhance safety, train detection in the yard ladder tracks is also being added utilizing wheel detectors to prevent the possibility of any switch being thrown under a train.

B. The work in this Section, as part of Contract shall consist of the design, manufacture, documentation, delivery, storage, installation, demonstration, testing, interface requirements and placing into service a Non-Vital Route Request and Indication System for the Central Light Rail Line (CLRL) in the North Avenue yard. This includes the associated subsystems, equipment, materials, cables, hardware, and appurtenances, to provide a complete operating system as described herein. The Route Request and Indication system shall work in conjunction with existing electric switch machines and associated wayside control pushbuttons, relay based switch operating circuits and relay based switch indication circuits. Contractor shall furnish the management, labor, data, design, programming logic, testing, services, training, manuals, parts, materials, tools, systems, equipment, appurtenances, and incidentals necessary to complete the work in accordance with all Contract requirements. The Non-Vital Route Request and Indication System shall be installed in the North Avenue yard and existing 94 interlocking as shown in the Bid Documents.

C. The Contractor's operations shall conform to all applicable State and Local regulations.

D. Wherever these Special Provisions refer to the Administration, they shall be understood to mean the Maryland Transit Administration (MTA). Whenever reference is made to Engineer, it shall mean the Administration's representative for the contract.

1. Submittals shall be made in accordance with Section 01300 Submittals.

E. All contractor personnel shall have the required Light Rail Railway Worker Protection Training along with valid MTA Contractor Badges. In addition, each work crew shall include at least one person who has been trained as an On-Site Coordinator.

1.02 CONTRACT DOCUMENTS: The work shall be performed in accordance with the following documents:

A. Volumes 1A and 1B (applicable to all portions of the work) - The General Provisions for Construction Contracts (GP's), issued by the State of Maryland Department of Transportation; the Supplementary General Provisions for Construction Contracts (SGP's) issued by the MTA; the Special Provisions (SPs) Sections (Divisions 1 through 17); the Notice to Contractors; the Liability Insurance Requirements; MTA Project Safety Plan; and the various forms and exhibits all issued by the Maryland Transit Administration of the State of Maryland Department of Transportation.

B. Volume 2 Drawings providing technical requirements and information relating to the work. The Contractor is not to regard these as design or construction documents.

C. All applicable codes, standards, and ordinances of Baltimore City and Baltimore County. Applicable sections of the Special Provisions contain references to Baltimore City or Baltimore County Standard Specifications. The Contractor is responsible for obtaining current copies of each referenced Standard prior to commencement of work.

D. The contract specifications and drawings are intended to present the minimum equipment requirements, typical circuits and typical installation arrangements. The Contractor's design shall be produced following these minimum requirements and typical arrangements and shall include all necessary details. Any variance from the minimum requirements or typical arrangements shall be identified in the submittal process. Variances shall be submitted for improvements to, or correction of, the minimum requirements and typical arrangements set forth in these documents CDRL). The Contractor shall be solely responsible for the final design. Contractor's design shall include but not be limited to the following:

1. Switch control and indication circuits and software.
2. Route control and indication circuits and software.
3. Pushbutton control circuits and software.
4. Axle counter circuits, controllers and software.
5. Interface circuits and software.

6. Power circuits.
7. Mechanical layouts.
8. Cable duct and trough layouts
9. Maintenance Control Panel layouts, controls and indications.
10. PLC application logic
11. Test plan, procedures and reports
12. Electrical and mechanical layout drawings for all of the above.
13. All other incidental design related to the scope of work.

1.03 DEFINITIONS:

The following definitions supplement those specified in the General Provisions.

Alignment: The horizontal and vertical location of track, street or highway as described by curves and tangents.

Assembly: A self contained or easily identified package, whose integrated parts, devices, and structure perform a discrete function.

Block: A length of track of defined limits, the use of which is governed by wayside and/or cab signals.

Bond, Rail Joint: A metallic connection attached to adjoining rails to ensure electrical conductivity.

Circuit, Double Wire: An electrical circuit not employing a common return wire but formed by individual wires throughout.

Civil Speed Limit: Maximum allowable speed with respect to the geometry of the track relating to curves and grades.

Clearance: Distance between fixed wayside structures and the dynamic outline of a moving vehicle.

Clearance Point: Location on a turnout or crossover at which required clearance is provided between vehicles on diverging tracks.

Conductor Bus: A conductor or group of conductors, terminated as a common connection for 2 or more circuits.

Conflicting Routes: Two or more routes, opposing, converging, or intersecting over which movements cannot be made simultaneously without possibility of collision.

Consist: The quantity and specific identity of LRVs coupled together.

Contractor: The term Contractor, when used in this Specification will reference the signal contractor. All other contractors will be as specified.

Derail: A device designed to cause a train/LRV to leave the rails.

Facing Point Switch: A track switch, the points of which face traffic approaching in the direction of the switch.

Failsafe: A characteristic of a system, which ensures any malfunction affecting safety will cause the system to revert to a state known to be safe.

Fail Soft: A failure in the performance of a system component that neither results in immediate of major interruption of the system operation.

Failure: The inability of a system, sub-system, assembly, or component to perform its required function.

Firmware: Programming that is inserted into read only memory, thus becoming a permanent part of a computing device.

Indication: A message from an individual field location to report its status to the supervisory control system.

Input: An electrical signal external to a system and recognized by it as valid information to be processed.

Interface: The points where 2 or more systems, subsystems, or contracts must meet to ensure continuity and proper operation.

Interlocking: An arrangement of apparatus in which various devices for controlling track switches, signals, and related appliances are so interconnected that their movements must succeed one another in a predetermined order, and for which interlocking rules are in effect.

Internal Point: A point whose state is determined by the states of input, or output points as defined by ladder logic or communications. The state may also depend on the states of other internal points.

Junction: A location where routes converge or diverge.

Locking: The electrical or mechanical establishment of a condition for a switch, interlocked route, speed limit, or automatic function which cannot be altered except by a prescribed and inviolate sequence of unlocking.

Local Control: Mode where an interlocking is controlled from a panel located at such location.

Mainline: Portion of track other than that designated as Yard or Storage.

Memory: A device that stores a program for the purpose of execution by a CPU.

Milestone: Contractual completion date determined by the number of days required to complete an item of work, added to the Notice to Proceed date, or a specified calendar completion date.

Module: A component of a microprocessor, which performs a specific function and is designed to be readily removable for the purpose of reconfiguration, expansion or repairs.

Non-Vital: Any function, which does not affect the safety of train/LRV operation.

Output: An electrical signal generated by a system, the state of which depends upon 1 or more of its inputs.

Point: A specified input, output, or specific internal state as defined by the program of a programmable controller, or microprocessor which is assigned to a specific electrical terminal.

Pre-conditioning: A function of switch control circuitry that calls for the switch to move to the opposite direction before electric locking is released.

Programmable Controller: A solid-state device, which senses electrical inputs and generates electrical outputs, such outputs being dependent upon such inputs as defined by changeable logic.

Relay: An electrical device designed to interpret input conditions in a prescribed manner and after specified conditions are met, to respond to cause contact operation or similar abrupt change in associated electric control circuits.

Scan Time: Total time required for a microprocessor to sense the state of its inputs, solve its equations, and change the state of its outputs.

Supervisor LRC: An individual who supervises, and interfaces with, the entire CLRL system from LRC.

Track Circuit: An electrical circuit, of which the rails of a track form a part, used to indicate the presence of a train/LRV.

Trailing Point Switch: A switch, the points of which face away from the approaching traffic.

Vital Circuit: Any circuit whose functions affect the safety of rail operations.

Wayside: Area between and adjacent to the tracks within the right-of-way.

Word: A grouping of data bits of specified length, which is used as a unit of measure of a memory.

1.04 ABBREVIATIONS: The following abbreviations supplement those in the General Provisions:

Abbreviation	Meaning
AAR	Association of American Railroads
AREMA	American Railway Engineering and Maintenance of Way Association
AC	Alternating Current
AF	Audio Frequency
Amp or A	Ampere
AH	Ampere Hour
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASTM	American Society For Testing And Materials
AWG	American Wire Gauge
BTU	British Thermal Unit
C	Celsius
CIH	Central Instrument Houses
CLRL	Central Light Rail Line
CMT	Cable Management Tray (Fiber Optics)
CP	Clearance Point
CPU	Central Processing Unit
CSE	Cable Slack Enclosure
CWI	Crossing Warning Indicator
DC	Direct Current
EA	Each
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EEPROM	Electronically Erasable Programmable Read-Only Memory
EIA	Electronic Industries Association
EPT	Electrical Plastic Tubing
ERK	Emergency Restoration Kit (Fiber Optics)
F	Fahrenheit
FOC	Fiber Optic Cable
FOC-I-C	Fiber Optic Cable in Conduit
FRA	Federal Railroad Administration
FRE	Fiberglass Reinforced Epoxy
FS	Federal Specification
FT	Foot

GRS	Galvanized Rigid Steel
HSPF	Heating Season Performance Factor
Hz	Hertz
IEC	Institute of Electro-Technical Committee
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IJ	Insulated Joint
kWatt	Kilowatt
LED	Light Emitting Diode
LRC	Light Rail Control
LRV	Light Rail Vehicle
LS	Lump Sum
mA	Milliampere
MAS	Maximum Allowable Speed
MCM (kcmil)	Thousand Circular Mils
MIL – STD	Military Standard
MIL – HDBK	Military Handbook
MIN	Minimum or Minute
MNHR	Manhour
MO	Month
mph	miles per hour
mphps	miles per hour per second
mphpsps	miles per hour per second per second
MTA	Mass Transit Administration
MTBF	Mean Time Between Failures
MTSP	Maintenance Touch Screen Panel
MTTR	Mean Time to Restore
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
Nm	Nannometer
NTP	Notice to Proceed
NIC	Not In Contract
NVP	Non Vital Processor
OSHA	Occupational Safety and Health Administration
OSSP	Operational Signal Staging Plan
PB	Pushbutton
PCB	Printed Circuit Boards
PDR	Preliminary Design Review
PF	Power Frequency
PLC	Programmable Logic Controller
POS	Point of Switch
PROM	Programmable Read Only Memory
psi	Pound per Square Inch
PVC	Polyvinyl Chloride
RAM	Random Access Memory
RF	Radio Frequency

RFP	Request for Proposal
ROW	Right of Way
R,S&I	Rules, Standards and Instructions
SBD	Safe Braking Distance
SCADA	Supervisory Control and Data Acquisition
SEER	Seasonal Energy Efficiency Ratio
SHA	State Highway Administration
TPS or SS	Substation
TRACS	Traction Computer System
UL	Underwriters Laboratories
UMTA	Urban Mass Transit Administration
UV	Ultraviolet
UPS	Uninterruptible Power Supplies
V	Volts
VDC	Volts Direct Current
W	Watts
XLPE	Cross Linked Polyethylene

1.05 GENERAL SCOPE:

A. Description: Overall scope of work for the Non-Vital Route Request and Indication System project is to design, furnish and install a new Non-Vital Route Request and Indication System as well as new non-vital interlockings encompassing the North and South interlocking in the North Avenue yard and interfacing with 94N interlocking. This system shall provide detection of trains in the project area using wheel detectors. The wheel detectors shall be installed in accordance with the project drawings. Design, furnish and install normal and standby PLCs in south CIH. These new PLCs shall be capable of operating North interlocking, the combined South and 94 interlockings as two distinct interlockings. I/O for each of these CIHs shall be linked by fiber optic cable.

B. The project effort shall occur in the following areas:

1. North CIH:

2. South CIH:

3. 94N CIH

4. Yard Lead Tracks (adjacent to 94N interlocking)

5. Yard Tracks 1 thru 13 (south end of yard)

6. Yard Tracks 1 thru 13 (north end of yard)

7. Yard Tail Track

8. Existing yard switch pushbuttons

C. Optional Zones 5 thru 13:
As an additional option, the Contractor shall provide Zone 5 thru 13 for the north tail track and the storage tracks between the North and South portions of the yard. These zones shall utilize the same wheel detectors as used for Zones 1 thru 4.

1. Zones 5 thru 13 shall have the following capabilities:

   a. Detect train occupation of the north tail track and tracks 6 through 13 regardless of direction
   b. Determine the number of axles currently in a particular zone.
   c. Record the number of axles currently in a particular zone.

2. Any route shall be allowed into any of these zones irrespective of the existing state of occupancy.

3. The cost of providing this option shall be provided by the Contractor separate from the project cost.

Note to Bidders:

Existing, as-built drawings of the existing MTA Light Rail signaling facilities in the North Avenue Yard and at Location 94N are available as AutoCAD DWG files. CAD files for any contract drawings can be made available to the Contractor, but the Contractor will be responsible for validating all dimensions and layout configurations shown on these drawings.

1.06 GENERAL FEATURES:

A. Systems shall provide the functions of train detection, safe vehicle separation and route security through the yard interlockings as specified herein.

B. System control equipment shall be located along the track only where necessary. All other equipment shall be located in Central Instrument Houses (CIH) or wayside cases.

1. Apparatus typically located along the tracks includes the following:

   a. Interlockings:

      1. Wayside Pushbutton assemblies

2. Wheel detectors
3. Cable trough
4. Handholes
5. Conduit
6. Cabling
7. Wayside Instrument Cases
8. Junction Boxes

2. Apparatus located in interlocking and signal housings include:

a. Programmable logic controllers (PLC)

b. Wheel detector/Axle counter amplifiers, controllers and relays.

c. PLC I/O modules

d. Vital and Non-Vital relays and hardware

e. Interlocking control logic circuitry.

f. Maintenance panel touch screens

g. Power equipment.

1.07 REQUIREMENTS OF NON-VITAL ROUTE REQUEST AND INDICATION SYSTEM:

A. The Non-Vital Route Request and Indication System shall perform the function of two distinct interlocking systems. The Non-Vital Route Request and Indication System shall:

1. Establish and cancel the routes of trains by the use of route pushbuttons in the north and south areas of the yard.

2. Indicate a route has been selected by a flashing indication light next to the pushbutton. When the indication light is illuminated steady, this will indicate the route has been lined and detected in the requested position.

3. Establish and cancel the routes of trains by the use of a Maintenance Touch Screen Panel (MTSP) in the north or south

CIH in the north and south areas of the yard. Controls shall enable complete routes or individual switches to be selected or cancelled. MTSPs shall also display route status indications, switch position indications and track occupancy status.

4. Operate yard switches from the existing yard switch pushbuttons in the north and south areas of the yard.

5. Detect the presence, on any portion of the track, of an LRV or track maintenance equipment.

6. Prevent conflicting routes.

7. Control direction of LRVs on a given section track.

8. Provide independent operation of the north and south interlockings

1.08 SYSTEM OPERATION:

A. The North interlocking, the combined South and 94N interlockings shall each have 3 modes of operation:

1. Route Pushbutton Operation:

Route Pushbutton operation shall be enacted from the maintenance touch screen panel and shall be the primary method of operation in the yard.

In route pushbutton operation, train operators may select routes from any of the wayside pushbutton panels in the yard. Pushbutton route selections may occur in the South or North portion of the yard independent of each other. However, only one route selection may be made at a time in the North portion of the yard and a maximum of three non-conflicting selections may be made at a time in the South portion of the yard. Pushbutton panels will have pushbuttons and indication lamps identified for each available exit track.

- Before a selection for a track is made, indication lamps will be dark.
- If a route is not available because a conflicting route has been established and/or a train is occupying any portion of the route, the indication lamp shall flash to indicate that the route request has been received by the PLC but cannot be implemented.
- When a route is available, the indication lamp corresponding to the selected pushbutton shall flash while

any switch in the selected route is out of correspondence with the required position.

- When all switches in the route selected have been lined and detected in the requested position, the indication lamp will illuminate steady, telling the operator it is safe to proceed.

A cancel pushbutton will also be provided at each pushbutton panel. Should the train operator wish to cancel a selection already established, the cancel pushbutton will cancel the existing route. When the cancel pushbutton is used, the steadily illuminated indication lamp will be extinguished. After this occurs, the train operator may select another available route. A single Cancel pushbutton shall cancel all routes available from that panel.

a. Train movements into and out of the MOW storage track: Train movements into and out of this track will require the use of a key switch. This key switch must be operated before the route selection can occur. While the key is turned, the pushbutton selection may proceed. No moves into or out of the MOW storage track will occur successfully without the use of the key switch.

2. Maintenance Touch Screen Panels:

Maintenance Touch Screen Panels shall be located in the south and north yard CIHs. The maintenance touch screen panels shall both display a schematic of the entire north and south yards including the scissors crossover at 94N interlocking. Icons resembling pushbuttons shall be displayed at each potential entrance track and will initiate alignment of the desired route when the screen is touched. When this occurs, the affected route shall flash as well as an indication icon for the particular route. When the route is lined and detected in the requested position, the display shall change to reflect the change in switch position and indicate the route is lined and detected in the requested position by changing the color of the route to illuminate steady white. In addition, the indication icon for the particular route shall illuminate steady. When a train occupies the route, the route indications shall change from white to red.

MTSP icons shall be operated through the use of drop down menus indicating all of the operations to be performed at the pushbutton or switch. These menus shall include but not be limited to the functions of select, cancel, normal, reverse, exit, as applicable to route or switch functions

The maintenance touch screen panels shall display icons at all switch locations in the yard schematic. These icons shall be used to operate the switches in the yard individually for test purposes. Their operation shall be similar to a unit lever operation. When operated the display shall indicate switch operation by flashing the image of the switch. When the switch attains correspondence, the image of the switch shall appear solid in the direction requested. Modes of operation, i.e. route pushbutton, MTSP, and LRC (future) and existing yard switch pushbuttons will be selected by touching corresponding icons on the MTSP. Switching between modes of operation shall retain a previously selected route. For the controls and indications of the MTSP, refer to specification section 17175.

a. MTSP Operation Restrictions:

1. Both MTSP panels as well as the LCP at 94N interlocking cannot be operated at the same time. The MTSP in the South CIH shall have priority for MTSP operation of the South Yard Interlocking, the MTSP in the North CIH shall have priority for MTSP operation of the North Yard Interlocking and the Existing 94N LCP shall have priority for the 94N interlocking followed by the South Yard MTSP and lastly the North Yard MTSP.

2. Selection of a mode of operation from an MTSP shall inhibit the operation of the remaining modes for that particular MTSP but not the other.

3. Selecting a southward pushbutton route at 94 interlocking shall not be inhibited if the MTSP panel at south interlocking is in operation.

4. Track and /or switch blocking initiated from an MTSP shall only be released from that MTSP.

3. Existing yard switch pushbutton operation will be enacted from the maintenance touch screen panel and shall be used for switch testing purposes only. During this operation, switches in the yard may only be operated from the switch pushbuttons located adjacent to each individual switch movement in the yard. When this mode is in effect, switches shall be operated directly from the adjacent pushbuttons without intervention from the interlocking or detector locking protection.

4. LRC Control (future)
   a. Allow for future operation of the Yard interlockings via a network connection to the Light rail Control Center. Functionality shall be the same as described for the MTSPs.

1.09 SCOPE OF WORK:

A: In addition to the General Scope, the scope of work for this contract shall be as follows:

1. All work shall be in accordance with these Specifications.

2. Contractor shall furnish, install and test new wayside pushbutton assemblies where indicated in the contract documents. Existing pushbuttons at 94-2, 94-4 shall remain in place but the pushbutton and indication devices shall be replaced with the same devices used in all the new pushbutton panels.. Existing pushbuttons at 94-6, 94-8 shall be upgraded and renamed as shown in the contract documents. This shall include but not be limited to the pushbutton enclosures, pushbuttons, indication lamps, cabling terminal boards, wiring, cabling detectors, junction boxes, cabling, interface relays, foundations, masts, mast bases, hardware, and all appurtenances required to provide a complete system.

3. Contractor shall furnish, install and test, wheel detectors in accordance with the contract documents. This shall include but not be limited to the rail mounted wheel detectors, junction boxes, cabling, amplifiers, wheel detector controllers, relays, hardware, and all appurtenances required to provide a complete system and interface the detection section statuses with the PLC.

4. Contractor shall furnish, install, and test separate normal and standby non-vital Programmable Logic Controllers (PLCs) in the south CIH.

   a. The normal PLC shall be the primary controller and perform all of the logic and processing necessary to maintain yard operation as described in the contract documents. The normal processor shall interface to other subsystems, i.e., the I/O modules, the MTSP, fiber optic links to the LRC and other adjacent CIHs.

   b. The standby PLC shall be the secondary controller; perform all of the functions and interface to all of the subsystems as the primary controller. The standby PLC shall share the

same I/O as the normal PLC.

c. In the event of a PLC failure, PLCs shall have the ability to switch between normal and standby without loss of functionality in any operating mode.

d. The PLCs shall have the ability to be switched between normal and standby manually without loss of functionality in any operating mode.

e. The redundant PLC shall be powered from three independent power supplies; one for the normal PLC, one for the stand-by PLC and one for the I/O modules.

5. Contractor shall provide remote I/O modules as necessary in the North CIH and the 94N CIH. Connect the North CIH I/O, South CIH PLCs and 94N CIH I/O with 12 strand fiber optic cables configured in a closed ring such that if any one element of the ring is broken, all communication is maintained through the remaining segments of the ring.

6. Power for all equipment in the North, South and 94N CIHs shall be derived from existing power buses in each CIH. Contractor shall provide all necessary circuit breakers, fuses, wire, transformers, power supplies, surge suppressors, terminals and any other required components to interface all new equipment with the existing power distribution systems.

7. Contractor shall provide all interfacing circuits and revisions to existing circuits in accordance with the contract documents to ensure the Non-Vital Route Request and Indication System for the North CIH and South CIH as well as existing 94 CIH operate as a complete system

   a. Interface circuits for LRC shall be provided in accordance with the Bid Documents. This shall include fiber optic cabling to the LRC and all hardware necessary to provide control and indication of the Non-Vital Route Request and Indication System to LRC. It shall be the responsibility of the Contractor to coordinate with the Administration to guarantee that the interface signaling equipment has the appropriate communications protocol with existing and/or new Light Rail Control equipment

8. Submittals:

   a. Contractor shall submit all information required by these Specifications. It shall include all design drawings and documents, samples, test plans, test procedures and test

results submitted in the approved order.

b. Signal drawings shall be submitted as specified in Section 01300. It shall be the responsibility of Contractor to complete the design for this system and provide a complete set of Working Drawings. This shall include complete details of all equipment, circuits, and their physical layouts, all in accordance with established fail-safe signaling and train control practices. All design drawings shall be sealed by a registered professional engineer registered in Maryland. ***Autocad*** files for all contract drawings will be made available to the Contractor.

c. In addition to shop drawings and product submittals, Contractor shall submit systems drawings for a Preliminary Design Review (PDR) (CDRL) and Final Design Review (FDR) (CDRL) and shall participate with the Administration in design review meetings. Following successful system test, Contractor shall submit as-built versions of all drawings, including pdf and original CAD electronic files and electronic copies of all PLC software. All drawings shall compliment and supplement existing drawings. Existing drawings shall be revised where necessary.

9. Products and Materials: Contractor shall furnish, unless otherwise specified in the Contract, all material, implements, machinery, equipment, tools, supplies, transportation, and temporary utilities necessary for the execution and completion of the work.

a. Contractor shall supply all documentation and spare parts, and provide training as specified in Section 17271. Contractor shall provide a signal engineer and other personnel necessary as approved by the Administration to support operations and safety certification as specified in these Bid Documents.

10. Design: Contractor's design shall be consistent with the principles and practices depicted in the contract typical drawings. System drawings shall include but not be limited to the following:

a. System Design: Provide system design as required, operational descriptions and all other system type designs that depict system operational requirements.

b. Product Design: Provide detail design, circuits, drawings, test results and documentation of necessary components, and subsystems in conformance will all requirements specified in these Specifications.

c. Circuit Design: Provide the circuitry, detail design, testing, circuit check and drawings in conformance with all requirements specified in these Specifications.

d. Software Design: Provide all of the programming for the PLCs necessary to furnish a complete system. Including but not limited to interface between PLCs, new and existing I/O, and communications in conformance with all requirements specified in these Specifications.

e. Installation Design: Provide complete electrical and mechanical design and drawings for installation of all required equipment in conformance with requirements of these Specifications.

11. Testing:

a. All testing shall be done in accordance with the contract documents.

b. Factory Acceptance Testing: It shall be the responsibility of the Contractor to perform factory acceptance testing of all PLCs, Wheel detectors, pushbutton assemblies and their supporting equipment. It shall be the requirement of the Contractor to do complete system testing of all equipment used or interfaced with existing CIHs or intermediate cases. Contractor shall develop a Factory Acceptance Testing procedure and submit to the Administration for approval (CDRL).

c. Field Testing: Contractor shall obtain approval for the test plan and procedures as set forth in these Specifications prior to start of field testing. Contractor shall successfully complete all tests necessary to ensure the Non-Vital Route Request and Indication System operate according to these Specifications.

12. Trackside Equipment Clearance:

a. Installation of signaling equipment in the North Avenue Yard shall be in accordance with CLRL clearances.

1.10 PRELIMINARY SIGNALING SYSTEM CIVIL WORK:

A. Non-Vital Route Request and Indication System: It shall be responsibility of the Contractor to furnish and install the civil infrastructure. This will permit the Contractor to install signal cables and wayside equipment without major excavation of the track and right of way. Civil items to be installed, but not limited to, are as follows:

1. Route pushbutton foundations.

2. Handholes and interconnecting conduit system to connect wayside devices to new and existing cable trough system.

3. Cable trough as shown on the contract drawings to supplement the existing cable trough network.

4. Grading of equipment area.

B. It shall be the Contractors responsibility to furnish and install the civil infrastructure to support the new signaling system at the following locations:

1. New Pushbutton assemblies.

2. Handholes and conduits.

3. Wheel detectors

4. Junction boxes

5. Cable trough

1.11 RETIRING AND REMOVAL OF EXISTING SIGNAL EQUIPMENT:

A. Contractor shall retire and remove only the existing signaling equipment indicated on the contract drawings. All retired equipment shall be returned to MTA. The storage location of retired signaling equipment will be furnished by the Administration. These items include but are not limited to:

1. Relays and bases.
2. Wayside Pushbutton assemblies.
3. Equipment Padlocks.

B. Contractor shall be responsible for the removal of existing equipment foundations.

1.12 STAGING:

A. The Non-Vital Route Request and Indication System is scheduled to occur over a 15 month period. During this period, interim staging of existing and new signaling equipment shall be required. It shall be the responsibility of the Contractor to submit a Staging Plan (CDRL) and provide all necessary manpower and equipment to meet the needs of temporary and final signaling transitions. Contractor's work shall consist of, but not limited to, the following:

B. Design, install and test interim signaling circuits.

C. Design, install and test interim interface signaling circuits.

D. Furnish, install and test interim signaling equipment.

E. Furnish, install and test temporary signaling cables.

F. Provide, up to date circuit plans that reflect all interim changes.

G. Provide operations descriptions for all interim operating situations.

H. Provide on-site assistance in event of signaling system failures during interim operations.

1.13 PLANS, SCHEDULES, REVIEWS, DOCUMENTATION, WARRANTY, TRAINING, ETC.

A. PROJECT MILESTONES

The following project milestones shall be completed based on the contractor's project schedule (P/S) accepted by the Administration as follows:

Milestones In Calendar Days			
		Completion From Contract NTP	**Administration Review Period**
	Project Specific Safety and Health Plan	5 Days	21 Days
	Plans and Schedule Contract Data Requirements List Project Management Plan QA/QC Plan Migration Plan Project Schedule	10 Days	21 Days
	Preliminary Design Review	30 Days	21 Days
	Final Design Review	90 Days	21 Days
	Training Program - ***Plan, trainer documents and trainee documents submitted for approval***	120 Days	28 Days
	Operating Documentation ***(O & M Manuals for approval)***	210 Days	28 Days
	Factory Acceptance Test	180 Days	21 Days
	Field Installation Acceptance Test	360 Days	21 Days
	All O & M Training	***360 Days***	***21 Days***
	Thirty Day Operational Test	390 Days	21 Days
	Project Completion except Software Upgrades and Warranty	450 Days	30 Days
	Software Upgrades	30DOT plus 180 Days	21 Days
	Warranty	FIAT plus 365 Days	30 Days

B. PROJECT MIGRATION PLAN AND PROJECT SCHEDULE

1. Contractor shall utilize a well-defined methodology to manage the life cycle of activities needed to complete this project. Contractor shall keep the Administration involved throughout the project life cycle so as to minimize the risks associated with misunderstanding the detailed requirements.

2. Within ***twenty one (21)*** days after receipt by the contractor of the Notice to Proceed, the Contractor shall deliver the Project Migration Plan and Project Baseline Schedule. Detailed PERT charts, with the critical path identified (using CPM), showing when tasks occur, when resources are required, and what tasks dependencies exist shall also be included as detailed in Section 01300. The Project Migration Plan and Project Schedule shall be of sufficient detail and clarity so that the work can be controlled and the administration can monitor progress during the life of the project. The charts shall indicate a logical sequence of work and identify all dependencies, personnel resources, material, equipment, and work areas required for completion of the work. The degree of detail shall be sufficient to identify at a minimum:

   a. Major contract phases, milestones and deliverables as specified both within the contractors' system development and installation methodology and those specifically identified throughout the contract documents.

   b. Project events with associated tasks and sub-tasks.

   c. Interfaces and dependencies with preceding, concurrent, and succeeding work effort.

   d. Resources needed and assignments down to other task levels for staff, material, work site and equipment.

3. Contractor shall deliver the Yard Route Pushbutton System consistent with the approved Project Migration Plan and Project Schedule. Changes to the milestone completion dates must be approved by the Administration in advance. Subject to such approval, the Contractor must ensure that the Project Schedule/Migration Plan contains any changes, updates or new information related to the project's status, or any other requirement, deliverable or feature related to the performance of the Yard Route Pushbutton System different from the information which the contractor included in its design. The Migration Plan will be revised to reflect revised approved schedule.

4. The Project Schedule shall be updated per Section 01300, to reflect current status and shall be delivered to the Administration not less than two days prior to regularly scheduled project progress meetings. At these progress meetings the Contractor must advise the Administration of any project slippage, deliverable delay, change in project organization, or program.

C. SYSTEMS DESIGNS

Contractor shall complete the Systems Design in two phases. The Preliminary Design shall culminate with a Preliminary Design Review (PDR) which shall consist of a 70% Systems Design and be submitted in accordance with the Project Schedule (CDRL). The Final Design shall culminate with a Final Design Review (FDR) which shall consist of a 100% Systems Design and shall also be submitted by the Contractor in accordance with the Project Schedule (CDRL). The Systems Final Design must be approved by the Administration prior to the start of any manufacturing, installation or construction work, unless specifically pre-approved by the Administration.

1. Preliminary Design

The Preliminary Design shall include the following features:

a. Contractor shall provide a Preliminary Design, which shall provide the features, functions and technical specifications of the system at 70% completion level. The design documentation provided shall include the documentation as provided in section System Design Documentation.

b. In the course of completing the Preliminary design, the Contractor shall obtain the necessary user input on key open design questions that the Contractor may have, and conduct site visits to confirm the operation of the existing systems and equipment and collect data necessary to assist the Contractor in completing the Preliminary Design.

c. The Contractor shall schedule, at a minimum, monthly Preliminary Design progress meetings with the Administration.

d. The Preliminary Design life-cycle shall proceed in the following sequence and include:

i. Progress Meetings

ii. Issue Preliminary Design documents

iii. Completed PDR review session with the Administration

iv. Administration internal PDR

v. Administration comments to Contractor

vi. Comment review and approval to commence Final Design

2. Final Design Review (FDR) - 100% Systems Design

Contractor shall provide a Final Design subsequent to review and approval of PDR by the Administration, which shall provide the features, functions and detailed technical specifications of the system at 100%

complete level. The final design documentation provided shall include the documentation as provided in section System Design Documentation.

a. The Final Design life-cycle shall proceed in the following sequence and include:

i. Progress Meetings

ii. Issue Final Design documents

iii. Completed final design review session with the Administration

iv. Administration internal FDR

v. Administration comments to Contractor

vi. Comment review and updated Final Design documents

vii. Approval of Final Design Documents by the Administration

D. SYSTEMS DESIGN DOCUMENTATION

Systems Design Documentation shall be provided to the Administration in accordance with the approved project schedule and migration plan. At minimum, the design shall contain the following:

1. Systems Documentation

a. Executive Summary: a summary of documentation material provided in all deliverables, an overview of the entire system describing all major components (System and sub –Systems) of the Yard Route Pushbutton System, and special features of the Yard Route Pushbutton System which address performance, expansion, system security, ease of use, and maintainability.

b. System Architecture: a system-level graphic representative of all hardware components and their interconnections. This shall include identification of the interfaces between all existing and proposed devices and systems.

c. System Processing Narratives: detailed narrative descriptions of each major processing activity to be performed by the Yard Route Pushbutton System. The narratives should describe how all equipment and software interacts to satisfy the functional requirements of the Yard Route Pushbutton System. These narratives shall be clear and comprehensive explanation of how each of the Administration's functional requirements is supported by the Yard Route Pushbutton System.

d. Security Features: a description of all system security features, computer controlled and physical, designed into the Yard Route

Pushbutton System to control and monitor the systems and its components. In addition, describe all features, components and equipment which protects the Yard Route Pushbutton System from physical hazards such as electrical power surges, brown-outs and black-outs.

e. Failure Handling and Recovery: a failure/recovery matrix showing the types of failures, the process of reporting these failures and if automatic or semiautomatic. This shall include descriptions of system diagnostics to detect and isolate failures.

2. Computer and Field Equipment Software Documentation

a. Software Architecture: system level illustrations, such as flowcharts and block diagrams. Illustrating the overall structure of the Yard Route Pushbutton System systems. These diagrams shall include the major processing functions performed by each subsystem or major module, their interaction with each other and with the Yard Route Pushbutton System users.

b. Software Configuration: a description of the operating system, application, database/data management, utility, graphical user interface, device drivers and any other software used in the Yard Route Pushbutton System. Contractor shall identify which software is to be custom developed and which is third party software. For third party, the Contractor shall explain the functions to be performed by the product and identify the manufacturer, version and release to be used and shall submit all technical specifications and literature (CDRL). For custom software the Contractor shall identify the languages, compliers, and utilities to be used in development and operation.

c. Database and Data Management Structure: a description of the overall organization of the files and/or database to be used in the Yard Route Pushbutton System. This description shall include, but not limited to, full details regarding any third party database products including version, release, functional characteristics, operational requirements, and any other relevant characteristics of the products.

d. Data Dictionary: a listing of all Yard Route Pushbutton System data elements, including the size, definition, validation rules and other information pertaining to the elements. If a commercially available data dictionary is to be used the Contractor shall also submit complete and current information about the product (CDRL).

e. Data Storage Analysis: the techniques employed to ensure that the Yard Route Pushbutton System can meet the storage requirements for on-line and historical data, and expansion capabilities. The analysis shall include identification of all files, databases and their retention cycles.

f. Operator Interface: Describe the operator and user tools and techniques employed to ensure an easy to use, consistent and efficient interface between the operator and the Yard Route Pushbutton System. Include all operator screens and icons including

the configuration/state of each icon for each equipment state.

g. Program and Module: Narrative description of major program modules contained in the Yard Route Pushbutton System and the description of the processing functions, inputs and outputs of these modules.

h. Detailed Software Design: block diagrams, flow charts and/or other software design documentation that describe the design of the Yard Route Pushbutton System software by major subsystems. This information shall include the details of main processing functions performed by each program or module, including inputs, outputs and data type definitions.

i. Inputs and Outputs: a description of all Yard Route Pushbutton System inputs and outputs. Inputs and Outputs to be received/sent by the operator shall include descriptions of all transactions, messages, records, signals, screens, reports, and menus. Contractor shall provide the documentation for field structures of messages and records and the methodology for redefining menu structures.

3. Hardware Documentation

a. Hardware Specifications: a full bill-of-material and complete specifications for each hardware element of the Yard Route Pushbutton System. Hardware specifications must include an expansion of equipment functionally and theory of operation.

b. Component Drawings: drawings that clearly and completely indicate the function of each Yard Route Pushbutton System hardware component. The drawings shall indicate termination points of devices and interconnection required for system operation, interconnection between modules and devices, spacing of components and location, mounting and positioning details.

4. Field Equipment Documentation

a. Hardware Specifications: a full bill-of-material and complete specifications for each field element of the Yard Route Pushbutton System. Equipment specifications must include an expansion of equipment functionally and theory of operation.

b. Component Drawings: drawings that clearly and completely indicate the function of each Yard Route Pushbutton System equipment element. The drawings shall indicate termination points of devices and interconnection required for system operation, interconnection between modules and devices, spacing of components and location, mounting and positioning details.

c. Detailed conduit and cable drawings (end-to-end), schedules, including equipment locations, cable plans and wiring/termination diagrams. All cables and individual wires shall be uniquely identified. For any cables not conforming to a recognized standard, all conductors within the cable shall be uniquely identified.

5. System Operating Documentation

a. Contractor shall provide all documents, manuals, and printed materials necessary for the effective operation of the Yard Route Pushbutton System systems. The documents provided shall be in bound copies and also provided in an electronic version as described in the Specification Section "Submittals". This documentation shall include, but not be limited to the following specific manuals:

i. Standard Operations Procedures Manual: This manual shall be provided to include graphical depictions and explanations of the system operation for all operator functions. This manual shall be for instructional, study, and refresher use and shall explain all features and functions of the Yard Route Pushbutton System systems for day-to-day operations. The manual shall also have a section on problems and/or exception conditions so operators can resolve common operating problems. The manual shall also contain instructions on how to perform normal maintenance. This Manual shall be submitted for approval (CDRL).

ii. Systems Administrator's Manual: This manual shall be provided to include graphical depictions and a written description of all functions required for software modifications and development. This manual shall contain all procedures necessary for the monitoring and administration of the Yard Route Pushbutton System systems. At a minimum, the manual shall contain separate sections for the following topics: Start up and shut down procedures, instructions for the cold start of the systems equipment, back-up and recovery, performance analysis, scheduled maintenance, user management, audit and control, report production, configuration control, system diagnostics, data base integrity, special requests, and expendable supplies. A separate removable section of the Yard Route Pushbutton System Administration Manual shall contain information on the proper administration and control of the security features built in to the Yard Route Pushbutton System. Some of the information in this section shall include maintenance of user identifiers, password control and security policy review. Information on appropriate review of security control for adherence through various types of reporting mechanisms and utilities and/or third party security software. This Manual shall be submitted for approval (CDRL).

iii. Supervisor's Manual: This manual shall be provided to include graphical descriptions of all functions and procedures required for system modifications specified under supervisor training. This manual shall contain all the instructions included in the Operator Procedure Manual plus instructions on printing standard and ad-hoc reports. This Manual shall be submitted for approval (CDRL).

iv. Refer also to Section 01301 for additional requirements for operations and maintenance manuals.

E. SEALING OF PROJECT DRAWINGS

All completed system design drawings developed for this contract by the contractor shall be sealed by a professional engineer registered in the state of Maryland prior to being issued for manufacturing or on-site construction. A PE seal will not be required on standard device or component drawings or on shop drawings if there is a sealed design drawing that covers the work shown on the shop drawing. As-built revisions of contractor developed sealed design drawings shall also be sealed by a Professional Engineer registered in the state of Maryland. The engineers who seal the drawings shall be involved throughout the design process as required by the regulations governing the conduct of professional engineers. As-built mark-ups of sealed Contract Drawings shall be submitted to the Engineer (CDRL).

F. SYSTEMS DEVELOPMENT

Contractor shall be required to integrate all system components into a fully functional system consistent with the requirements set forth herein or as may be approved pursuant to the RFP and approved FDR Systems Design, and consistent with the contract approved system document. Contractor shall complete the programming, parameterization and any tailoring needed to customize or otherwise modify commercial-off-the-shelf (COTS) products for the Administration. Contractor shall provide detailed "Change Control Procedures" for handling hardware and software upgrades to the Yard Route Pushbutton System after the approval of FDR. Contractor shall provide appropriate controls to ensure that the source code production load modules are synchronized in all versions and revisions at all facilities.

G. IMPLEMENTATION AND MIGRATION

Contractor shall be responsible for implementing the system design and integrating the Yard Route Pushbutton System with the existing system. Contractor is required to submit updates to the Migration Plan (CDRL), describing all activities and task associated with the installation and implementation of the system at the facilities. The Migration Plan submitted and approved concurrently with the PDR and FDR Systems Design submittals shall phase in migration from existing system to the new system. As part of the migration plan, Contractor shall provide documentation addressing equipment reliability projections, systems administration and procedural changes that will result from the migration to the new system

1. Installation

Contractor shall install hardware, infrastructure, communications equipment software and systems provided for under this contract in accordance with local building codes, National Fire Protection Association, the National Electrical Code and all other applicable standards and industry practices. Contractor shall furnish all labor, tools, cable conduit and supplies required to install all equipment and systems. Contractor shall remove and dispose of all debris at no additional costs to the Administration. The installation of any new equipment shall not

impact the existing equipment or communications networks. Power capacity for the system is available in each CIH. Power distribution, conditioning and any requirement for additional power will be at the Contractor's expense and subject to approval by the Administration. Contractor shall define their times and method of equipment delivery, which is subject to the Administration's review and approval.

2. Cutover to Yard Route Pushbutton System

Contractor shall cutover to the new system consistent with the Migration Plan which shall include at least the following tasks:

a. Install and test the new systems control equipment consisting of PLCs and maintenance control panels.

b. Provide documentation of all problems and corrective actions that occur while implementing the Yard Route Pushbutton System and create a historical database to be used in future development and/or changes to the Yard Route Pushbutton System.

c. After successful migration to the new systems and equipment, disconnect and remove all retired equipment

3. Removal of Existing Equipment and Material

a. All active equipment that is decommissioned shall be disconnected and removed.

b. Upon commencement of installation work, the Contractor shall make all efforts to complete the work in a minimum amount of time. In the event of slippage from those schedules, additional shifts as required, including Saturdays, Sundays and Holidays shall be scheduled to complete the work at no additional cost to the Administration.

c. The Migration Plan should also address periods of time/duration during the migration process when components of the existing Yard Route Pushbutton System may be taken out of service. Since scheduled interruption of the existing equipment should be known in advance of the event. Notice to the Administration for these interruptions shall be in accordance with the red tag requirements as specified in the contract. Scheduled interruptions must be kept to a minimum.

H. SYSTEM TESTING AND ACCEPTANCE

Contractor shall conduct a full program of testing, the purpose of which shall be to demonstrate to the Administration's satisfaction that the Yard Route Pushbutton System Project fulfils all specifications and requirements as set forth herein.

Note: The definition of a test plan shall consist of test plans and procedures which detail a description of the item to be tested, the inputs/outputs/expected results, test scenarios, test scripts, material and equipment required for execution of the test(s), an itemization and supplying of all special tools and devices needed

to perform the test, and the documentation of these details in a certified test report.

1. Pre-Acceptance Testing

   During the Yard Route Pushbutton System development phase and prior to the Contractor's submission of formal acceptance test plans and procedures the contractor shall test all material, equipment including software and hardware components individually and as an engineered system to ensure that they perform according to the specifications as set forth herein.

2. Acceptance Testing Plan

   Within 30 days of Final Design Documents approval or per the approved schedule, the Contractor shall prepare and deliver to the Administration for review and approval a comprehensive Acceptance Test Plan for all material and equipment, including software and hardware components, that describes all activities and tasks associated with testing during test phase, i.e., Factory, Field and Operational.

3. Acceptance Test Reports

   When all tests for a testing phase, test sub-plan or test plan/sub-plan have been executed to the satisfaction of the Administration, the Contractor shall prepare and deliver to the Administration an Acceptance Test Report along with the Contractor's written certification that the Yard Route Pushbutton System has successfully passed all tests for that specific test phase.

4. Factory Acceptance Test (FAT)

   All material and equipment including software and hardware components required to complete the Yard Route Pushbutton System project shall be inspected, by the Administration, at the Contractor's place of manufacture or development. Prior to the initiation of FAT, the Contractor shall provide final draft copies of all System Operating Documentation described herein.

5. Field Installation Acceptance Test (FIAT)

   After installation of the integrated system, and agreement by the Administration to initiate testing, the Yard Route Pushbutton System equipment and components shall be tested in compliance with the FIAT Plan.

6. Thirty Day Operational Test (30DOT)

   After Administration approval of the FIAT for all systems, stations and facilities, the Contractor shall begin the 30DOT. At that time, the Yard Route Pushbutton System equipment and components shall perform in

accordance with the approved 30 Day Operational Test Plan, under full operating conditions, for a period of thirty consecutive calendar days. Thirty Day Operational Test Plan shall address the operation of the overall integrated system. During the 30DOT, all subsystems will be fully functional and operational for 30 continuous days.

I. EXCHANGE AND EXPANSION EQUIPMENT DURING FACTORY, FIELD AND OPERATIONAL TESTING

Contractor shall certify in writing to the Administration when exchange or expansion equipment, devices, or components are installed and ready for use. For the purpose of this section, "expansion" is used to denote equipment which is not specified in the approved final design Bill of Materials. Contractor shall provide an Installation Date Certification for equipment or component. If this occurs during the 30DOT, the operational test shall recommence on the first Administration work day following acceptance of the Contractor's Installation Date Certification.

J. TRAINING

A Training Program shall be provided by the Contractor in order to provide initial and ongoing training for all users of the Administration Yard Route Pushbutton System.

1. Contractor shall develop and implement a training database configuration to train staff on the use of the integrated system. This training configuration should address the functions and operation of the Yard Route Pushbutton System Integrated, in real-time simulation of typical alarm events and responses.

2. Refer to Section 01301 for additional requirements.

K. WARRANTY

1. Warranty Service and/or Period

a. The warranty period shall be in accordance with the requirements of SGP 4.05 unless specifically identified to be longer in other sections of these specifications. The warranty period for each system at each station shall commence after the FAIT test results for that system at that location have been submitted and accepted by the Administration. The warranty period for the Yard Route Pushbutton System hardware shall commence when all the new hardware has been placed into service. During the Warranty Period, the Contractor shall provide Warranty Service on all equipment and software furnished under the Yard Route Pushbutton System Contract such that the Yard Route Pushbutton System will perform in accordance with the Specifications set forth herein. In addition, for the Yard Route Pushbutton System, the Contractor shall provide a warranty covering software defects and system stability starting when the Yard Route Pushbutton System hardware is placed into revenue service and continuing until 12 months after successful completion of the 30DOT.

b. The warranty period for spare parts shall extend either 12 months after the beginning of operation or until 2 years after acceptance, whichever occurs first. In the event it is necessary to place any spare parts into operation or service prior to the completion of the warranty period, the Contractor covenants and agrees to furnish and deliver free to the Administration a replacement part for the Administration's spare parts inventory.

c. For every identified system fault, the Administration will first endeavor to correct the fault with their own forces as trained by the Contractor. In the event that the Administration's maintenance forces are unable to correct the fault within four hours, the Administration may request the Contractor to provide assistance The Contractor shall have personnel available twenty-four (24) hours a day, seven (7) days a week to perform warranty services. If personnel are designated as "On-call", they shall be able to report for duty no longer than eight hours after callout. Performance of the Yard Route Pushbutton System in accordance with the documents herein, and the approved "as-built" documents shall be referred to as performing in "Working Order".

2. Warranty Service of the Yard Route Pushbutton System shall include:

a. On-site diagnosis and repair of defects in the equipment and software furnished herein; as well as technical support regarding the operational use of the Yard Route Pushbutton System. Contractor shall provide diagnosis and fault isolation participation in any and all intra or inter facility communications troubles affecting the Yard Route Pushbutton System, regardless of whether maintenance is provided by the Contractor or a third party. In the event the Yard Route Pushbutton System is not in Working Order, the Contractor shall dispatch service personnel to the Work Site as described herein.

b. Repair or replacement of all removed defective components, irrespective of whether the component was replaced by the Administration or by the Contractor.

c. In the event Yard Route Pushbutton System is not working in accordance with the Specification and the Administration needs on-site assistance, the Contractor shall dispatch service personnel to the Work Site to arrive within 8 hours of notification by the Administration.

d. In the event that the Yard Route Pushbutton System is not in Working Order, and the Contractor has exceeded either of the standards of System Availability because of a malfunction which, in the opinion of the Administration, is unlikely to be resolved by the Contractor, the Administration may, at the Contractor's expense, restore the Yard Route Pushbutton System to Working Order or provide a work around. Contractor shall credit to the Administration

the expenses associated with any third party work up to the amount of the Monthly Warranty Payment.

e. Contractor shall identify service personnel who will be assigned to perform maintenance and warranty service for the Administration during the Warranty Period. This information shall be provided prior to the start of the 30DOT.

f. Contractor shall provide error corrections, updates and new releases to any proprietary software, and correction releases to third party software after obtaining a) the written approval of the Administration and b) documentation updates to reflect these software changes within fifteen (15) days of completion of said software updates. Errors shall include flaws in operation as defined in the manuals supplied to the Administration and errors due to flaws in the design and coding of the software. Contractor shall also make new releases of third party software available to the Administration at the Administration's option and expense.

g. Contractor guarantees and warrants that work done and items procured shall (a) meet the requirements of this contract, (b) be free from defects in design, materials and workmanship, and (c) be free of all liens, encumbrances and other rights and interests of third parties. This guarantee and warranty shall apply to all discrepancies and defects that are discovered within twenty four months after the date of system acceptance. Remedial work to correct warranty defects shall be performed by the Contractor at a local repair facility, and shall include repair or replacement at the Contractor's option. Contractor shall not make any design modification to any component during the warranty period without the prior approval of the Administration.

h. In the event the Contractor fails to comply with its warranty obligations, Administration shall, upon written notice to the Contractor, have the right to deduct the downtime credits from any compensation due or which become due to the Contractor. In the event the Contractor has been paid, the Contractor agrees to compensate Administration for the costs thereof.

i. Spare parts shall be interchangeable with their corresponding part. All spare parts shall be reconfigured to the latest revision during the warranty period. Contractor shall have available at least two U.S. sources for spare parts. Contractor shall also endeavor to have other spare parts available from two U.S. sources. A detailed list of all spare parts with manufacturer name, model number, quantities required to be on hand and costs for one year after parts are out of warranty shall be provided.

j. Contractor is solely responsible for all costs of parts and/or labor incurred during the Warranty Period.

1.14 SUPPORT DURING INITIAL YARD OPERATIONS:

It is the Administration's intent to perform long-term maintenance with their own forces. During initial yard operations, Contractor shall provide technical assistance in troubleshooting, repair and maintenance as required. Contractor shall observe and support the Administration's maintenance personnel and advise them of necessary actions to provide a high level of quality maintenance. Contractor's total manpower requirement for this support during initial Route Pushbutton Control operations shall be 40 man-hours with a maximum of 10 occasions of 4 man-hours for each occasion. This support shall be on site support. Contractor provided support shall include but not be limited to one field engineer, one field technician, and one 1 foreman. Response time for these personnel shall be not more than 12 hours from the time contacted by the administration.

1.15 SOFTWARE UPGRADES

The Administration has defined in these contract documents the performance requirements for the PLC software. However, it is recognized that once the system is in operation, there may be some elements of system functionality that Light rail Operations or maintenance may prefer to function in some other manner. Software upgrades and/or revisions shall be provided at any time after successful completion of the FAT until 6 months after completion of Work Item 2 – Completion of all Contract Work (01110-1.17, Table-1.

A. The Software Upgrades payment item shall only be used for upgrades or changes directed by the MTA such as changing approved existing features or adding features. Any changes required because the system is found not to function as specified or as defined in the Contractor's approved design documents shall be corrected at the Contractor's expense.

B. When this payment item is to be used, MTA will define the details of the change or upgrade in writing and request an hour estimate to complete the work including installation, testing and updates to all applicable software documentation.

C. Changes may be to any application software furnished by the Contractor including, but not necessarily limited to the PLC application software, GUI display or GUI/PLC interface.

D. Software upgrades shall be implemented by personnel who are thoroughly familiar with the system as supplied by the Contractor and preferably by the same personnel who developed the application software.

E. Changes shall be implemented using the same development software furnished to MTA. If the Contractor would prefer to use the development software copy provided to MTA, then accommodations will be made to allow the Contractor's personnel to work at the North Avenue shop facility.

1.16 **SPARE PARTS,** SPECIAL TOOLS AND EQUIPMENT:

As specified in Section 17690

1.17 LICENSES

All licenses associated with all software and hardware provided by the Contractor shall be irrevocable and shall not have any ongoing, time based charges to the MTA.

1.18 COMPLETION TIME, DURATION OF PERFORMANCE AND LIQUIDATED DAMAGES:

A. Pursuant to General Provisions, commence work on or before the date specified in the Notice to Proceed (NTP) and complete the specified portions of the work in Table 1 within the number of calendar days specified and without causing disruptions to train service.

B. The final contract completion date will be 90 calendar days after the date for project completion that appears in Table 1. The date for project completion that appears on the Contractor's approved project schedule to the 90th day after that date shall be referred to as the 90-Day Period. No charges or claims for damages shall be made by the Contractor for any delays or hindrances, from any cause whatsoever, during the progress of any portion of the work specified in this contract that occurs in the 90-Day Period. Furthermore, no liquidated damages may be assessed by MTA for Contractor delay that occurs during the 90-Day Period.

C. In the event that the Contractor fails to complete the work within the specified number of days plus the non-compensable time per the above paragraph 1.16 B after Notice to Proceed, liquidated damages will be assessed pursuant to General Provisions for each calendar day the completion of the specified work is delayed, or occurrence of disruption of service during the period of this Contract.

TABLE 1

WORK ITEM	NUMBER OF CALENDAR DAYS	LIQUIDATED DAMAGES PER CALENDAR DAY
1. Completion of FIAT	360 Days plus 90 Days	$1,370.00
2. Completion of <u>All</u> Contract Work except Software Upgrades	450 Days plus 90 Days	$1,370.00

D. The Contractor shall pay to the Administration the applicable amount specified and pursuant to General Provisions as liquidated damages for every additional calendar day in excess of the number of days prescribed or for violations of the contract as listed above. The Administration may deduct the sum of liquidated

damages from any monies due or that may become due the Contractor under the Contract, or if such monies are insufficient, the Contractor or sureties thereof shall pay to the Administration any deficiency within 30 calendar days.

E. Other contracts and contractors associated may be present in the project area during the construction period. The Contractor shall coordinate shared access at construction locations during track closures and at other times. Where this coordination results in restriction to the Contractor's work site access, the Contractor shall provide for workarounds to allow the continuance of construction. These workarounds shall not constitute a basis for a contractor delay or extension claim or for additional cost to the Administration in any way.

F. Other schedule requirements are given in Section 01300 Submittals

1.19 CONTRACTOR REPRESENTATIVES AND STAFF QUALIFICATIONS:

A. Designate in Writing within 5 days after receiving the Notice to Proceed (NTP), the name, official mailing address and telephone number of the Contractor's representative having complete Authority to represent and to act for the Contractor and the subcontractors.

B. Critical project work, such as system design, installation, transition and testing shall be performed by personnel who are qualified by their experience to perform such work, so that the system is delivered to the Administration in a fully functional and safe operating condition. Design work shall be overseen by professional engineers registered in the state of Maryland.

C. If, in the opinion of the Administration, any contractor's personnel are not satisfactory in the performance of services to be finished hereunder, the Contractor shall remove such personnel and replace them with personnel satisfactory to the Administration. Qualifications of any of the Contractor's personnel shall be presented to the Administration upon request.

1.20 LIABILITY INSURANCE REQUIREMENTS:

A. The Administration has chosen to provide Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective coverage on behalf of contractors and subcontractors working on this project. This approach to project insurance is commonly called a wrap-up or Owner Controlled Insurance Program (OCIP). Specific information regarding Liability Insurance Requirements is contained in the Contract Specification Book. (See Table of Contents for location of this information.)

B. Contractors and subcontractors are to bid work for this project net of insurance (i.e. The Cost of Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective applicable to the work site is not be to included in the bid price). All bidders must complete the Insurance Premium Worksheet (provide in the in the contract documents) and forward to the Administration with the rest of your price package. The Premium

Worksheet is included in the bid package herein. This form should include the Contractor's work as well as the work of all subcontractors included in the initial bid. The insurance premium shown on this form, or the pro rata portion thereof, will be added to the base bid in the event you are excluded from the wrap-up program or the program is terminated mid-term.

1.21 WORK RESTRICTIONS

A. Vendors shall adhere to the following requirements for scheduling access and work schedules should reflect the following general and location specific access restrictions:

1. Contractor access to facilities is coordinated two weeks in advance through the Administration's Metro Red tag and Work Block coordination meetings.

2. Weekly "Red Tag" meetings are held to coordinate contractor's work areas, schedule MTA escorts, plan track access, power outages or any other variances of normal service activities.

1.22 WORK SEQUENCE:

A. Contractor shall sequence all construction work in phases to accommodate the Administration's operating and occupancy requirements during the construction period and in accordance with the approved migration plan, staging plan; coordinate construction schedule (project schedule) with the Engineer.

1.23 CONTINGENT ITEMS:

A. Construction items for which quantities are listed in the Unit Price Schedule as "Contingent" are established for the purpose of obtaining bids on one or more pay items that may be incorporated into the project.

B. The Engineer will have sole discretion in determining whether and to what extent these items will be incorporated into the project. The Engineer may order these items to be used at any location within the project and anytime during the work. In most cases contingent items will not be shown on the Plans. The estimated quantities specified in the Unit Price Schedule for these items are presented solely for the purpose of obtaining a representative bid price. The total of actual quantities required for the construction may be only a fraction of, or many times the estimated quantity. The requirements of GP-4.04 (Variations in Estimated Quantities) shall apply.

1.24 ELIMINATED ITEMS:

A. Should any Contract items contained in the Unit Price Schedule be found unnecessary for the proper completion of the work contracted, the Engineer may, upon written order to the Contractor, eliminate such Contract items from the Contract.

B. No allowance will be made for items so eliminated in making final payment to the Contractor except for material costs incurred prior to notification of the eliminated of the items.

PART 2: PRODUCTS

2.01 OTHER OPERATIONAL REQUIREMENTS:

A. Failover Capability: If any interlocking is being controlled from the LRC at the time communications is lost between LRC and the interlocking, such loss of communications shall be detected and the interlocking automatically returned to the route pushbutton mode.

2.02 PRODUCT REQUIREMENTS:

A. Provide a proven and modern Non-Vital Route Request and Indication System within project limits as shown, in both system wide aspects and component design. Contractor shall demonstrate through the submittal of documents at least 5 years revenue experience in a transit environment.

B. All equipment and material shall be standard products of manufacturers regularly engaged in the production of signal and control equipment and material, and conform to the UL, NEMA, ANSI, AREMA standards, where applicable. All products provided in this Contract shall require approval of the Administration.

C. Assemblies and components that perform identical functions within the systems shall be mechanically and electrically interchangeable. Standardized, commercially available components of multiple sources shall be used whenever possible, particularly for items which require replacement at predictable intervals.

D. American Railway Engineering and Maintenance of Way Association (AREMA) Requirements: All electronic devices and components shall conform to requirements of Section 14 of the Signal recommendations of AREMA.

2.03 MAINTAINABILITY DESIGN REQUIREMENTS:

These requirements are in addition to the maintainability criteria as specified in Section 17021.

A. All test points, indications and components requiring adjustment or replacement shall be visible and accessible while mounted in their normal position, without disassembly of other components.

B. Test points for checking essential voltages and waver forms shall be clearly labeled and be provided whenever required for troubleshooting and routine maintenance, and be capable of accepting probes and connectors used with standards equipment such as voltmeters and oscilloscopes. Accessible points shall be provided where signals are injected for testing.

C. Built-in indicators or meters shall be provided as necessary when frequent observations or adjustments are necessary. All electronic modules shall be equipped with LED or other approved indicators. They shall as a minimum demonstrate that each function of the module is performing correctly. All indicators shall be labeled.

D. The contractor shall design furnish and install an event recorder for each CIH as described in specification section 17177.

2.04 SAFETY REQUIREMENTS

These requirements shall be used in addition to the safety requirements as specified in Section 17021. Within the framework of the overall performance goals of the system, all control methods, circuitry, mechanical equipment, and operating procedures provided by Contractor shall conform to these requirements. Whenever an unsafe condition could develop from an equipment failure, fail-safe design technique shall be used to prevent the occurrences of the unsafe condition.

A. The PLC programming while being non-vital, shall emulate the circuit check and design methods used for vital signal circuits. This shall include but not be limited to the following:

1. Route locking
2. Detector Locking
3. Time Locking
4. Switch Control and Indication
5. Other methods as described in section 17195

B. Equipment failures and conditions which shall be considered when producing this design:

1. Vital Relays
2. Non-Vital Relays: Open coil, high contact resistance, shorted turns.
3. Absent and abnormal input signals.
4. Opens and shorts inputs and at outputs.

C. The design shall minimize the possibility of unsafe failure arising from procedural error and neglect, including:

1. Careless adjustment of equipment and controls.
2. Incorrect assembly of equipment.
3. Insufficient maintenance.

2.05 IDENTIFICATION METHODS: All signal equipment modules, assemblies, subassemblies and wires shall be identified by means of tags or other means as specified in Section 17263.

2.06 ELECTROMAGNETIC COMPATIBILITY:

A. Ensure the Non-Vital Route Request and Indication System shall operate in its specified operational environments. Contractor shall ensure the Non-Vital Route Request and Indication System will not suffer from or cause harmful electromagnetic interference, either conducted, radiated, or induced.

B. Make provisions in the design for the radiated, conducted and induced emission from other electrical systems in addition to those supplied under this Contract.

PART 3: EXECUTION

3.01 INSTALLATION: Unless modified elsewhere in these Specifications, electrical installation shall be governed by the provisions of the NEC Standard of the National Board of Fire Underwriters for Electrical Wiring and Apparatus, and AREMA manuals. All provisions of these Codes shall be considered applicable whether or not specifically mentioned in these Specifications.

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL REQUIREMENTS:

A. With the exception of Support During Initial Yard Operations and Software Upgrades, no separate payment shall be made for the work required under this Section. All costs in connection therewith will be considered included in the bid items requiring their use.

B. Support During Initial Yard Operations will be measured by the hour and paid for at the contract unit price including all costs for travel and living.

C. Software Upgrades will be measured by the hour and paid for at the contract unit price including all costs for travel and living.

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS
PART 1: GENERAL

1.01 DESCRIPTION:

A. The Work of this Section consists of furnishing basic electrical materials and methods applicable to electrical work for installation of systems specified in other sections, except as may be modified in those sections. The electrical work includes installation of systems for transformation, transmission, or distribution of power and data used for operation of surveillance equipment.

B. Related Work Specified Elsewhere:

1. Section 01110 – General Requirements
2. Section 16060 – Grounding and Bonding
3. Section 16135 – Underground Duct Work

1.02 QUALITY ASSURANCE:

A. Materials specified shall meet or exceed the requirements of the cited references.

B. Productions tests shall be performed on materials and certified by the Manufacturer.

C. All components and materials shall be UL listed.

1.03 SUBMITTALS:

Submit the following in accordance with SUBMITTALS, Section 01300, and with the additional requirements as specified for each:

A. Provide manufacturer's standard catalog data for all items described in this specification indicating conformance and compliance with standards and criteria indicated (CDRL).

B. Manufacturer's description, shop drawings, installation and operational instructions (CDRL).

C. Proof of compliance with NEC requirement to be listed and approved (CDRL).

PART 2: PRODUCTS

2.01 GENERAL:

A. Materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified.

B. All associated hardware (including but not limited to screws, bolts, nuts, strut, and washers) for exterior junction boxes, pullboxes, conduit and mounting components shall be stainless steel.

C. Galvanized coatings shall comply with ASTM A123 and A153.

D. Repair of galvanized coatings shall comply with ASTM A780.

2.02 GALVANIZED RIGID STEEL CONDUIT (GRS) AND FITTINGS:

A. Conduit, couplings, condulets, conduit bodies, elbows, fittings, and nipples shall be hot-dip galvanized and shall meet the requirements of ANSI C80.1, FS WW-C-581 and UL 6.

B. Conduit fittings and conduit bodies shall be threaded type connections, material shall be malleable iron with galvanized or zinc plated finish complying with ANSI/NEMA FB1.

C. Expansion fittings grounding and bonding jumpers shall be braided tinned copper with malleable iron clamps

D. Nipples shall not have continuous running threads. Continuous running threaded conduit shall not be permitted.

E. All conduit supports and associated components shall be galvanized or zinc plated malleable iron conduit with spacers or stainless steel strut, spring nuts, and clamps.

2.03 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS:

A. Tubing, couplings, condulets, conduit bodies, elbows, and fittings shall be galvanized and shall meet the requirements of ANSI C.80.3 and UL 514B.

B. Expansion fittings grounding and bonding jumpers shall be braided tinned copper with steel clamps.

C. Fittings shall be set-screw type complying with ANSI C.80.3 and UL 514.

2.04 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS:

A. Liquid-tight flexible metal conduit shall be zinc-coated galvanized steel with moisture, oil, and sunlight resistant PVC jacket complying with UL 360.

B. All liquid-tight flexible metal conduit of 1¼ inches diameter and smaller shall have a continuous copper bonding conductor spiral wound between the convolutions.

C. All liquid-tight flexible metal fittings shall be galvanized or zinc coated steel complying with ANSI/NEMA FB 2.

2.05 POLYVINYL CHLORIDE (PVC) COATED GALVANIZED RIGID STEEL CONDUIT, FITTINGS AND ACCESSORIES:

A. Coated conduits, fittings, elbows and couplings shall be coated with a minimum coating thickness of 20-mils of polyvinyl chloride complying with FS WW-C- 581, NEMA RN 1, and UL 6.

2.06 POLYVINYL CHLORIDE RIGID CONDUIT (PVC) AND FITTINGS:

A. Schedule 40 and schedule 80 conduits shall comply with NEMA TC 2 and UL 651 and have the following properties:

1. Flammability: ASTM D635, self-extinguishing.

2. Tensile Strength: ASTM D638, 6,000 psi at 78° F.

3. Flexural Strength: ASTM D790, 12,500 psi.

4. Compressive Strength: ASTM D695, 4,000 psi.

5. Hardness: ASTM D2240 (Durometer D) 77.

6. Water absorption: ASTM D570, 0.03 percent maximum, in 24 hours at 72° F.

7. Dielectric strength: ASTM D149, 1,100 volts per mil.

B. Conduit cement and primer: As recommended by the conduit manufacturer.

C. All polyvinyl chloride conduit fittings shall be rigid schedule 40 or schedule 80 complying with NEMA TC3 and UL 514B.

D. All polyvinyl chloride conduit spacers shall be thermoplastic interlocking type.

2.07 CONDUIT EXPANSION FITTINGS:

A. End couplings shall be of the same material as those of conduits to be coupled.

B. Neoprene sleeves attached to the end couplings by stainless steel bands shall accommodate an axial expansion or contraction from normal of ¾" minimum in either direction, parallel misalignment of the axis of coupled conduit runs in any direction of ¾" minimum and an angular misalignment of the axis of coupled conduit runs, in any direction, of 30°.

C. A tinned flexible copper braided bonding jumper, integral with the expansion fitting shall be attached to the end couplings to provide electrical continuity for all metal conduits.

Note: Cable Tray

All cable tray shall be approved by the Engineer prior to use and this approval will be allowed in limited locations.

2.08 STEEL CABLE TRAYS:

A. Steel trays shall be ladder type or ventilated solid bottom type as required and shall be hot-dip galvanized after fabrication in accordance with ASTM A386. The trays shall be designed to comply with the requirements of NEMA VE 1.

2.09 FIBERGLASS CABLE TRAYS

A. Fiberglass trays shall be ladder type, manufactured from fiberglass reinforced polyester resin, designed as follows, in accordance with NEMA FG-1:

1. Dimensions – Inside usable depth shall be four inches minimum. Outside depth shall be six inches maximum.

2. Fitting Radius – 24 inches

3. Rung Spacing – Maximum nine inches between centers

4. Working Load – 50 pound per linear foot on a maximum span of eight feet with a safety factor of 1.5

5. Fabrication – Straight section shall consist of rungs located between channel-shaped side rails

6. Flame Spread Index – ASTM E84, 25 maximum

7. Smoke Density – ASTM E84, 450 maximum

B. Covers – All cable trays inside the substation shall have snap-on construction covers.

2.10 METAL FRAMING AND WIREWAYS

A. Metal Framing (Continuous Slot Metal Channel System) – Comply with the following requirements:

1. Channel – Steel, ASTM A569 Where used as a raceway and lighting fixture support, channel shall be listed by UL as complying with UL5 for use as surface raceway and support for lighting fixtures with electric discharge lamps.

2. Configuration – Single channel or two single channels welded together. Channels shall accept spring-held steel nuts.

3. Single Channel Dimensions – 1-⅝ inch by 1-⅝ inches, 12 gauge

4. Double Channel Dimensions – 1-⅝ inch by 3-¼ inches, 12 gauge

5. General Fittings Dimensions, for Flat, Angular and U-Shapes – ¼ inch thick by 1-⅝ inches wide, unless otherwise indicated.

6. Channel, Pipe Clamps, and General Fittings Finish – Hot-dip galvanized after fabrication, ASTM A386, as applicable.

7. Nuts, Bolts, and Screws Finish – Electro-deposited zinc coating, ASTM B633, Class Fe/Zn 5, Type III.

B. Wireways – Galvanized sheet steel with screw covers, complying with UL 870.

2.11 JUNCTION AND PULL BOXES:

A. Exposed junction boxes and pullboxes, installed outdoors or in locations subject to moisture, shall be NEMA 3R or 4X, galvanized/zinc plated malleable iron with integrated tapered threaded hubs or stainless steel with rain-tight threaded hubs and metallic insulated bushings.

B. Concealed or interior junction boxes and pullboxes, installed in dry locations, shall be NEMA 1 or 12, galvanized/zinc plated steel.

C. All junction boxes and pullboxes rated NEMA 3R, 4X and 12 shall have covers with gaskets.

D. All boxes shall be equipped with at least one #10-32 tapped grounding screw hole and screw.

E. All boxes covers shall be of same material.

2.12 **EMBEDDEDOR DIRECT BURIED HANDBOXES:**

A. Handboxes shall be high impact resistant polymer concrete with open bottom, heavy vehicle traffic load rated box and non-skid lid with neoprene gasket, stainless steel penta head captive bolts, and MTA approved logo.

B. Size shall be 13 inches wide by 24 inches long by 12 inches deep.

C. MTA logo shall be: "MTA ELECTRIC" OR "MTA COMMUNICATIONs" as indicated on Contract Documents.

2.13 **HANGERS AND SUPPORTS :**

A. Hanger rods shall be hot-rolled steel ½ inch diameter (minimum) threaded the full length with sufficient distance at each end to permit at least 1-1/2 inches of adjustment. Conforming to ASTM A575 and A576.

B. Electro-deposited zinc coating conforming to ASTM B633.

C. Multiple Conduit Horizontal Members:

1. Standard structural steel shapes such as stainless steel angles or channels, 1½ by 1½ or $1^5/_8$ by $1^5/_8$ inches, 12 gauge, stainless steel cold-formed, lipped channel, and designated to accept special spring-held hardened stainless steel nuts for securing hanger rods and other attachments.

2. Two (2) or more channels may be welded together to form horizontal members of greater strength than single channel.

3. All associated hardware (including. But not limited to, screws, bolts, nuts and washers) shall be stainless steel.

D. Design:

1. Capable of supporting a load equal to the sum of the weights of the conduits and wires, the weight of the hanger itself, plus 200 pounds.

2. The stress at the root of the thread of the hanger rods; not more than 9,475 psi at design load.

3. Size the horizontal member such that the maximum stree will be not more than 12,650 psi at design load.

2.14 GROUNDING AND BONDING:

A. Per SECTION 16060 - Grounding and Bonding and Contract drawings.

2.15 WIRING DEVICES:

A. Receptacles:

1. Receptacles shall be extra heavy duty specification grade thermoplastic nylon with side screw terminals, bonded yoke, and #8-32 ground screw.

2. Color shall be black or brown.

3. Receptacle NEMA configuration shall be as indicated on Contract Documents.

4. Cover plates shall be stainless steel of configuration required for device.

2.16 CONDUIT TAGS:

A. Conduit tags shall be 1½ inch diameter 3-ply acrylic with black core and matte yellow front and back with quarter inch laser engraved lettering.

2.17 NYLON TIES STRAPS:

A. Nylon tie straps shall be a heavy duty UV (sunlight) resistant nylon with a stainless steel self-locking metal tab, and 50 lb. minimum tensile strength, sized to suit the application.

2.18 CONDUIT MEASURING TAPE AND PULLSTRING:

A. Tape and pullstring shall be 3/16 inch wide; rot, mildew and waterproof proof polyester with permanently printed measurements every foot, tangle proof, and 200 lbs tensile strength.

2.19 FIRESTOPS AND SMOKESTOPS:

A. Sealant compound shall be flexible, latex based, ready-mix mortar or caulk type providing tight seal complying with ASTM E814 or UL 1479.

B. Forming material shall be noncombustible, high-melt mineral fiber insulation containing a 4 lb cubic foot density and zero smoke development complying with NAFA 220, ASTM C665, Type 1 and E136.

2.20 **UNDER GROUND DETECTABLE WARNING TAPE:**

A. Underground detectable warning tape shall be metallic 6" wide 5-mil double-laminated permanently black-lettered color coded per APWA standards: Electric – Red.

PART 3: EXECUTION

3.01 **GENERAL:**

A. Installed work shall be in accordance with applicable requirements of NFPA 70 and shall comply with the current version of the NEC and local codes.

B. Materials and equipment shall be installed and connected as recommended by the manufacturer.

C. Install electrical materials, equipment, appurtenances, and accessories in locations as indicated, rigid and secure, plumb and level, and in alignment with related and adjoining work to provide a complete and operable system. Do not weld electrical materials for attachment or support.

D. All exposed conduit shall be galvanized rigid steel unless otherwise indicated. Quick or split couplings shall not be utilized.

E. Electrical metallic tubing shall be permitted in architecturally finished interior NEMA 1 rated spaces. Electrical metallic tubing shall be concealed within walls and above ceilings in public spaces.

F. All embedded or encased conduit shall be schedule 40 or schedule 80 polyvinyl chloride unless otherwise indicated. If schedule 40 conduit is used under railroad tracks it shall be encased in concrete. Schedule 80 conduit used beneath railroad tracks need not be encased in concrete. Schedule 40 or schedule 80 conduit under roadways shall be encased in concrete.

G. All embedded or encased conduit stub ups or stub outs shall transition to polyvinyl chloride coated galvanized rigid steel prior to leaving concrete or earth. Minimum length shall be eighteen inches straight conduit or conduit elbow. Both shall be furnished and installed with a coated threaded coupling for the transition to exposed conduit.

H. All conduits shall be mandrelled after installation with mandrel of appropriate size for the particular conduit. Plug or cap mandrelled conduits

to protect installed conduit against entrance of dirt, moisture, or foreign matter.

I. Contractor shall install expansion fittings on all exposed or embedded conduit runs crossing contraction, construction, and expansion joints.

J. Embedded conduits shall be supported and spaced prior to concrete placement or backfilling.

K. Conduits shall be pitched to provide moisture drainage to the nearest handhole, manhole, pull box (or away from equipment enclosures).

L. Conduits shall be rodded, or wire brushed, and swabbed prior to the installation of cables and conductors. After cleaning conduits, pull strings shall be installed and the conduits and outlet boxes shall be capped and sealed until installation of cables and conductors.

M. Field cut conduits shall be reamed to remove rough edges and burs.

N. When field cutting of concrete is required, thread and ream the conduit to remove any rough edges and clean off all cutting and threading oils by using an air drying solvent. Apply conductive ant-seize compound to the threads of all rigid conduit joints. Do not use compounds containing lead.

O. Conduit shall be brought to the shoulder of fittings and/or couplings and fastened securely.

P. There shall be no more than the equivalent of three 90° bends between boxes and devices.

Q. Polyvinyl chloride conduit shall be primed and cemented together as recommended by the manufacturer to ensure a watertight connection.

R. Conduits exposed to different temperatures shall be sealed to prevent condensation and passage of air from one area to the other.

S. Conduits shall be mechanically and if metallic electrically continuous.

T. All conduits shall be designated with conduit tags at each end of run and at all intermediate boxes. Tags shall be fastened with nylon tie straps.

U. Bushings shall be install on all conduit ends in outlet boxes and pull boxes.

V. Each conduit designated as "SPARE" shall have measure tapes/pullstrings. Ensure each tape/pullstring is free of splices, have ample exposed length and securely fastened on each end.

W. Hydraulic one-shot conduit bender or factory elbows shall be used for bends in conduit larger than 2 inch size.

X. Moisture traps shall be avoided where possible. Where unavoidable, a junction box with drain fitting shall be installed at the conduit low point.

Y. Conduits containing fiber optic cables shall utilize conduit sweeps and boxes maintaining fiber optic cable manufacturers' minimum bend radius requirements. Minimum conduit bend radii shall be twenty four inches, unless otherwise indicated.

Z. Embedded or direct buried hand boxes shall be installed on six inches of crusher run aggregate. All boxes installed in sidewalks, walkways, platforms, and roadways shall be flush with finish grade and all boxes installed in grass, mulch, or ballast areas shall be one inch above finish grade.

AA. ***Provide and install conduit between hand boxes and Route Selection Pushbutton Assemblies and Wheel Detectors as shown in Bid Documents.***

AB. Contractor shall drill platforms, floors, and walls, as required, to accommodate conduit runs with bit of correct size to permit proper conduit installation and sealing. All penetrations shall be sealed water tight and fire/smoke rated as required by requirements and regulations.

AC. Penetrations of existing fire walls and slabs shall not degrade fire rating and openings shall be sealed with approved fire rate methods and materials.

AD. Penetration of existing concrete slabs/floors, elevated platforms, and walls for conduits and other wiring devices shall be made only by core drilling. Chipping or hammering shall not be permitted. Openings around conduits shall be sealed with an approved patching materials and finishes.

AE. Junction and pull boxes shall be installed so that covers are readily accessible after completion of the installation.

AF. All work shall be performed in an orderly and workman like manner.

AG. Pull Strings: installed in all conduits with tensile strength not less than 200 pounds; free of splices, and having ample exposed length at each end; cap unused conduits with pull string in place, seal with pliable watertight sealant.

AH. Conduit entrances shall be sealed to prevent infiltration of dirt, moisture and rodents.

3.02 CABLE TRAYS, METAL FRAMING AND WIREWAYS:

A. Trays and wireways shall be supported by metal frame support or hangers of sufficient strength to carry combined weights of tray and cable and the dynamic loads imposed during cable pulling.

B. Electrical continuity shall be maintained between sections of steel tray by bolted copper braid and the steel tray connected to local grounding system.

C. AC and DC cables shall be installed in separate raceways. All DC power cables shall be installed in non-metallic raceways, unless noted otherwise.

3.03 JUNCTION AND PULL BOXES:

A. Junction and Pull Boxes:

1. Junction and pull boxes shall be installed so that covers are readily accessible after completion of the installation.

B. Boxes Set in Concrete:

1. Boxes shall be supported to prevent movement during concrete placement.

2. Boxes shall be sealed to prevent infiltration during concrete placement.

3. After concrete placement clean and cover boxes until installation of cables and conductors.

3.04 WIRING DEVICES:

A. Wire Terminations: All wiring shall be terminated with approved connectors and lugs. Provide adequate slack wire, one loop minimum, to prevent strain on terminations.

B. Crimped terminations: Crimping tools shall be as recommended by the termination device's manufacturer.

C. Exterior junction boxes, light fixtures, receptacles and switches shall be approved for wet locations with watertight cast type boxes with threaded hubs and equipped with gasketed covers with captive screws or twist type.

D. Equipment permanently connected to exterior receptacles or in areas subject to wet conditions or spray shall be equipped with watertight male plugs to suit.

3.05 WAYSIDE JUNCTION BOXES AND TERMINAL CASES:

A. Wayside Junction Boxes and Terminal Cases shall be installed such that no part, including doors in the open position, will project into the vehicle clearance envelope.

B. Terminate all conductors and cables on internal terminal blocks.

C. Install engraved placards on the exterior of the covers and/or door to identify the location.

D. Place copy of the wiring diagrams in the container provided.

E. Cable supports inside the enclosures shall be used to avoid straining terminations and to maintain an orderly installation.

3.06 GROUNDING AND BONDING:

A. Per SECTION 16060 – Grounding and Bonding.

3.07 FIELD TOUCH-UP:

A. Galvanized Metal Surfaces: Coat damaged surfaces to meet the finish of the original coating with polystyrene organic rich compound containing not less than 91 percent by weight metallic zinc powder in dried film.

B. Painted Metal Surfaces: Clean, prime and coat damaged surfaces with rust inhibiting undercoating and apply a finish paint coat system in accordance with manufacturer's instructions.

C. Damage Repair: Repair minor damage surfaces with materials and methods as recommended by the manufacturer. Major damage shall require complete component replacement as directed by the Engineer at no additional cost to the MTA.

PART 4: MEASUREMENT AND PAYMENT

4.01 BASIC ELECTRICAL MATERIALS AND METHODS:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 16135
UNDERGROUND DUCT WORK
PART 1: GENERAL

1.01 DESCRIPTION:

A. Work Included: The work specified in this Section includes the supply and installation of concrete-encased duct banks, direct buried conduits, hand boxes, and precast concrete manholes / handholes.

B. Related Work Specified Elsewhere:

1. Section 01300 – Submittals
2. Section 02310 – Excavation and Backfill
3. Section 03050 – Portland Cement Concrete
4. Section 03210 – Concrete Reinforcement
5. Section 03300 – Cast-In-Place Concrete
6. Section 16050 – Basic Electrical Materials and Methods
7. Section 16060 – Grounding and Bonding

1.02 QUALITY ASSURANCE:

A. Materials specified shall meet or exceed the requirements of the citied references.

B. Production tests shall be performed on materials and certified by the manufacturer.

C. All components and materials shall be UL listed.

1.03 CITED REFERENCE:

A. SECTION 01420 – Reference Codes and Standards.

1.04 SUBMITTALS:

A. Contractor shall submit as specified in Section 01300 SUBMITTALS and the following:

1. Catalog data on non-metallic conduit, metallic to non-metallic conduit couplings, hand boxes, manhole/handhole inserts, cable support materials, waterproofing sealer, concrete curing compound, and concrete dye additive (CDRL).

2. Shop drawings of precast manholes and handholes, which shall show all accessories including layout of cable supports (CDRL). The Contractor shall not commence the construction of the precast manholes and

handholes until the drawings are approved by the MTA and as required the City of Baltimore.

3. Conduit Plans (CDRL): Include for both interior and exterior work.

PART 2: PRODUCTS

2.01 MANHOLES AND HANDHOLES *(Not Applicable for Contract 0451-0240)*:

A. Manholes/handholes may be constructed monolithically or in sections. If the manhole is constructed in sections, the joint between sections shall be made watertight with an approved gasket or with an approved epoxy mortar grout.

1. Immediately after removal of forms, concrete surfaces shall be coated with an approved curing compound. The manhole opening shall be centered in the roof slab and ductbank knockouts shall be centered in the walls, unless otherwise noted.

2. Access opening shall be constructed in size and shape to accommodate the iron cover and frame.

3. Manholes and handholes shall include ductbank knockouts, riser conduit knockouts, a sump with galvanized grate and a minimum depth of two inches, a ground rod, 7/8 - inch minimum diameter galvanized steel pulling irons (8 per manhole, 4 per handhole), cable racks, and cast iron cover with lifting hooks.

B. Size: Minimum inside dimensions of manholes shall be as indicated on the Contract Documents.

C. Design Loads: Manhole and handhole design loads shall consist of live loads, live load impact, dead load, soil loads, hydrostatic loads, and any other excepted loads that may occur.

1. Live loads shall for H-20-44 AASHTO Standard Specifications for Highway Bridges. The design load shall be 16kips.

2. Impact loading shall be 30 per cent of the live load.

3. Soil loads shall consist of an earth cover over manhole from 0 ft. minimum of 5 ft. maximum. Average unit weight of earth shall be assumed to be 100 lb. per cu. Ft.

4. Hydrostatic loading shall be a hydrostatic head of 9 ft. above base of manhole.

D. The drawings shall be approved and signed by a Civil or Structural engineer registered in the State of Maryland.

E. Concrete: Cement for concrete shall be portland cement meeting the requirements of ASTM C150, Type I or Type II. Concrete shall be thoroughly cured and shall attain a compressive strength of at least 3000 psi before delivery, and 4000 psi before installation. The proportions of materials for concrete shall be as follows:

1. Minimum number of sacks of cement per cu. yd. of concrete – 7.

2. Maximum size of coarse aggregate in inches – 3/4.

3. Maximum slump in inches – 4.

F. Concrete reinforcing bars shall be in accordance with the provisions of Section 03210.

G. Exterior surfaces shall be waterproofed with 2 coats of waterproofing sealer. The sealer shall be applied when the manholes are manufactured and touched up in the field as required to repair damage during shipping and to seal field penetrations as specified in Subarticle 3.03D. The sealer shall be applied in accordance with the manufacturer's recommendations.

H. Ground rods shall be in accordance with Section 16060.

2.02 MANHOLE AND HANDHOLE FRAMES AND COVERS *(Not Applicable for Contract 0451-0240)*:

A. Manholes frames and covers shall be as indicated on Bid Documents. Manholes frames and covers shall be cast from gray iron in accordance with the applicable requirements of ASTM A48, Class 30. The transverse bending tests shall be considered the primary test for qualification and shall be conducted in accordance with the requirements of AST-438.

B. Cleaning and Inspection:

1. All castings which have passed the required tests shall be thoroughly cleaned, inside and out, without the aid of acid or other liquid and shall be subject to careful inspection and hammer tests.

2. The castings shall be the dimensions indicated on the Contract Documents and shall be free from sand or blow holes and cold shuts. No plugging or stopping of holes will be allowed. Casting lines and excess material shall be ground smooth.

2.03 CABLE SUPPORT *(Not Applicable to Contract 0451-0240)*:

A. Cable racks shall be surface mounted, with stainless steel bolts, to three 1/2 inch stainless steel anchor inserts, embedded and anchored to the reinforcement bars, and installed vertically, approximately two feet apart on each wall, without blocking any ductbank openings for the new or future duct banks.

1. The exact location and quantity of cable racks depend upon the exact locations of the precast duct bank knockouts in each style of manholes/handhole, and shall be subject to approval by the MTA and as required, the City of Baltimore.

2. Cable racks inserts shall be hot dipped galvanized, 4 feet long minimum (2 feet long minimum for handholes).

B. Contractor shall furnish hot-dipped galvanized cable brackets and porcelain cable supports, compatible with the manholes/handhole hardware as specified herein, or equal:

Wall Support	Cable Bracket	Porcelain Support
Unistrut type Channel	Kin Line #320-12	Kin Line #PCS 1500
T Slot Channel	Joslyn #J5133A	Joslyn #J5122
Pipe Socket	1" galv. Pipe	Gladding #301-A

2.04 EMBEDDED OR DIRECT BURIED HANDBOXES:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

2.05 WATERPROOFING*(Not Applicable for Contract 0451-0240)*:

A. Sealer for waterproofing exterior surfaces of manholes shall be a mineral colloid type asphalt emulsion, as manufactured by Hunt process Company "Acqu Shield 124", or equal.

2.06 GROUNDING AND BONDING:

A. Per SECTION 16060 – Grounding and Bonding.

2.07 AGGREGATE:

A. Per SECTION 02310 – Excavation and Backfill.

2.08 GROUT:

A. Non-shrinking, non-metallic grout shall be in accordance with ASTM C150 premixed compound capable of minimum compression strength of 4000 psi.

B. Water shall be clean and free of deleterious substances.

C. Non-shrinking, non-metallic grout shall be factory pre-mixed requiring only water addition in the field.

D. Shrinkage shall be in accordance with ASTM C827.

2.09 CONCRETE-ENCASED DUCT BANK:

A. Concrete encasement shall have a compressive strength at age 28 days of not less than 2500 psi. The maximum size of aggregate shall be 1/2 inch. The concrete shall be dyed red with an approved concrete additive.

1. Slump shall be between 4 and 6 inches. Concrete shall contain not more than 6.75 gallons of water per sack of cement. Consistency and workability for placement shall be obtained by the addition of a suitable type and amount of an air-entraining or water-entraining admixture, or both.

B. Conduits, fittings and spacers: Per SECTION 16050 – Basic Electrical Materials and Methods.

2.10 DIRECT BURIED CONDUITS:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

2.11 BACKFILL:

A. Per SECTION 02310 – Excavation and Backfill.

2.12 UNDERGROUND DETECTABLE WARNING TAPE:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

PART 3: EXECUTION

3.01 GENERAL:

A. Embedded or direct buried handboxes shall be installed on six (6) inches of aggregate. All boxes installed in sidewalks, walkways and roadways shall be flush with finished grade, and all boxes installed on grass, mulch, ballast areas shall be one (1) inch above finished grade.

B. Conduits shall be installed as shown on the Contract Documents.

C. All concrete slab or asphalt paving sections to be removed shall be neatly cut with a wet saw at limit of removal.

D. All restored concrete slab or asphalt paving sections shall match existing cross sections and finishes.

E. Backfill shall be compacted per SECTION 02310 – Excavation and Backfill.

3.02 EXCAVATION AND BACKFILL:

A. Per SECTION 02310 – Excavation and Backfill.

3.03 INSTALLATION OF PRECAST MANHOLES/HANDHOLES:

A. The contractor shall install precast concrete manholes as indicated on the Contract Documents and as approved by the MTA and, as required, the Baltimore City.

B. Manholes cover and frame shall be installed as shown on the approved shop drawings. Cover frame shall be adjusted flush with finish grade.

1. Within Baltimore City, weld manhole/handhole numbers to each cover. The numbering system shall be approved by the MTA and the Baltimore City prior to procuring manholes/handholes.

C. Install a ground rod in each manhole so that 8 inches of the ground rod protrudes above concrete floor and seal around ground rod with grout finished to match floor. Bond ground rod, by exothermic weld, to cable supports and all other metallic components with #1/0 AWG bare copper wire.

D. Field-apply 2 coats of concrete sealer to each exterior surface of the around the duct penetrations, conduit penetrations, frame, and field joints. Sealer shall be applied in accordance with the manufacturer's recommendations and must be of high quality to prevent water entry.

E. Penetrations around manhole/handhole conduits shall be sealed around all duct bank openings with approved non-shrink grout and waterproofing sealer.

3.04 INSTALLATION OF CONDUITS AND DUCTBANKS:

A. Direct buried or embedded conduit runs shall be non-metallic Schedule 40.

B. Conduits installed below grade shall be concrete encased unless otherwise indicated.

C. Conduit runs under tracks, platforms, parking lots, or roadways shall be encased in concrete.

D. Concrete encased conduits shall have three (3) inches minimum cover on all sides, unless otherwise indicated.

E. Buried or embedded conduits minimum size shall be one (1) inch.

F. Buried conduits shall be installed twenty-four (24) inches below finished grade unless otherwise indicated.

G. Buried conduits under tracks, roadways, and parking lots shall be installed thirty-six (36) inches (minimum) below finished grade, unless otherwise noted.

H. All conduit transitions from buried/embedded conduit to exposed conduit shall change to PVC coated rigid galvanized steel prior to leaving conduit. Minimum length of shall be eighteen (18) inches straight conduit or conduit elbow. Both shall be furnished and installed with a coated threaded coupling for the transition to exposed conduit.

I. All conduits and ductbanks shall be marked with appropriate underground detectable warning tape prior to completion of backfill and compaction at depth indicated on Contract Documents.

J. Conduit spacers shall be placed at 5 ft. intervals on center.

K. For concrete-encased ductbanks, the concrete shall completely encase the ductbank without disturbing its alignment or damaging the conduits.

L. Conduit terminations at manholes, handholes and hand boxes shall be fitted with end bells flush with finished surface.

M. At all stages of the work, the Contractor shall exercise care to prevent foreign material from entering the ducts. Each conduit shall be cleaned and tested by pulling a mandrel. Contractor shall give the MTA 24 hours notice prior to the cleaning.

N. Ductbanks connecting to manholes/handholes or underground structures shall be flared to have an enlarged cross-section at the manhole opening dimensions by less than 12 inches in each direction. The perimeter of the duct bank opening in the underground structure shall flared towards the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.

O. Ductbanks connections to existing manholes/handholes or underground structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

P. Where connections to existing ductbanks are indicated, excavate the banks to the maximum depth necessary. The banks shall be cut off and loose concrete removed from the conduits before new concrete-encased ducts are installed. A reinforced concrete collar, poured monolithically with the new duct bank, shall be provided to take the shear at the joint of the duct banks.

Q. Partially completed ductbanks or during construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering the ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 24 inches back into the envelope and a minimum of 24 inches beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 4 inches apart. Restrain reinforcing assembly from moving during concrete pouring.

R. Ductbanks and conduits shall slope down from building wall entry to prevent entry of water.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. 3" buried PVC conduit will be measured by the linear foot, installed in place with all backfill and surface restoration complete.

B. All other work required under this Section will not be measured for payment

4.02 PAYMENT:

A. 3" buried PVC conduit will be paid for at the contract unit price, installed in place with all backfill and surface restoration complete.

B. All costs in connection with all other work required under this Section will not be paid for directly, but will be considered incidental to the items of work to which it pertains.

END OF SECTION

SECTION 17139

CABLE TROUGH

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work of this Section consists of furnishing and installing the cable trough under this contract.

B. Related Work Specified Elsewhere:

1. Wayside Pushbuttons: Section 17123
2. Pushbutton Foundations: Section 17211
3. Wheel Detectors: Section 17142
4. Conduits: Section 17173

1.02 DEFINITIONS:

A. HDPC – High Density Polymer Concrete

1.03 OVERALL REQUIREMENTS:

A. Cable Trough shall be polymer concrete type.

B. Provide trough for installation as shown in the Bid Documents.

C. Trough sizes to be provided and installed per contract drawings.

D. ***Interface new trough to existing trough.***

E. ***Interface new and existing trough to new hand boxes to provide continuous protection for cables.***

1.04 SUBMITTALS:

A. Submit the following according to Conditions of the Contract and Division 01300 Submittals:

1. Product data for trough and miscellaneous components (CDRL).

2. Coordination drawings showing trough layout profiles coordinated with all system facilities, utilities, and all other existing and proposed installations.

1.05 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Experienced in providing underground utility structures of types and sizes required and similar to those indicated for this Project. The Manufacturer shall provide a list of references where these types of structures have been previously supplied.

B. Comply with NFPA70 "National Electrical Code" and ANSI C2 "National Electrical Safety Code" for components and installation.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Ship and store troughs with supports to prevent bending, warping, breakage, and deforming. Deliver troughs to site with ends capped.

PART 2: PRODUCTS

2.01 CABLE TROUGH:

A. Cable troughs and associated transitions shall be Plastibeton or approved equivalent.

B. Cable trough and associated transitions system shall consist of polymer concrete type. The trough material shall be resistant to ultra violet deterioration, impervious to chemicals and shall not absorb water.

C. Cable trough shall be sized and provided as shown on contract drawings. Trough dimensions are to support future work in North Avenue Yard. The sizes and transitions points are therefore required as shown however the detailed design shall be the Contractor's responsibility.

D. Product Specification:

1. The trough shall be provided in flame retardant compounds meeting Underwriter Laboratory UL-94 V2, V1, or V0 manufactured from high density polyethylene.

2. Provide manufacturer's plug caps for handling holes, leveling blocks and lid support brackets at "Tee" junctions.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Examine site to receive troughs for compliance with installation tolerances and other conditions affecting performance of the underground troughs.

3.02 EARTHWORK:

A. Excavation and Backfill: Adhere to the Administrations and manufacturer's installation and handling procedures.

B. Disturbed Paving: Restore disturbed paving to original condition.

3.03 CABLE TROUGH INSTALLATION:

A. Applications:

1. Cable trough shall be installed per manufacturer's installation instructions.

2. Cable trough shall be the primary cable duct from the CIH Manholes to each pushbutton and wheel detector location.

3. Cable trough shall be installed in track ballast and situated between and across tracks as shown on contract drawings.

4. Each trough sections shall be supported by manufacturer's leveling blocks at each end.

5. All trough intersections and transitions are to be cut in the field. Ninety degree intersections and transition shall only be permitted at trough connections to switch machines. All other transitions and intersections shall be at angles other than ninety degrees.

6. Use of "river rock", "washed stone/aggregate", or "pea gravel" as a backfill material will result in unacceptable performance and will not be accepted. The use of such rounded material is prohibited.

7. After trough is in place, plug all handling holes with manufacturer's plugs.

B. Cable trough shall be installed in the following configurations per manufacturer's installation instructions:

1. Cable Trough Transitions:

a. The cable trough shall be designed to accommodate a composite 3° bend between 2 joined sections which is sufficient to permit cable trough to parallel track curve without modification.

b. A handhole or a trough sweep shall be used when forming a 90° or "tee" intersection with cable trough.

c. A handhole shall be used for terminating straight runs of cable trough.

d. Larger vaults or manholes shall be used for accommodating slack loop storage for fiber optic cable or splice closures.

e. Transition products installation practices shall be the same as for the cable trough.

f. Install manufacturer's lid support brackets around "Tee" junctions.

2. Trench Restoration:

a. Backfill shall begin once the lids are installed on the total span length between vaults or manholes/handholes.

b. Returned or add ballast in layers of approximately 4 inches, compacting between layers. Work on both sides of cable troughs shall occur simultaneously. Ballast shall be clean, free of frozen material or organic matter.

c. Backfill material shall be compacted as described above.

d. During construction or periods when heavy vehicular traffic is anticipated, 1 inch thick steel plates shall be positioned over channels and lids extending 2 feet on to surrounding ballast.

e. It is acceptable to expose up to approximately 5 inches of cable trough sidewall above ballast grade. However, provision must be made to protect cable trough sidewalls from vehicular traffic. (See Bid Documents on details for specific layout and installation dimensions).

3. Between Track Installation:

a. Cable trough shall be buried in ballast up to the height of one inch above ballast. The cable trough shall be installed between parallel tracks in existing ballast. In all locations, material shall be removed as required providing sufficient depth for base preparation.

4. Cross Track Installations:

a. Cable trough installed between ties shall be one inch below bottom of rail. Trough level shall be adjusted to match to service road crossing elevations.

b. Cable trough shall be cut as required so trough installed in service aisle crossings shall match existing service aisle elevations.

c. Ties shall be adjusted as required to accommodate trough installations.

C. Cable Installation:

a. The cable trough inside surface shall be smooth and free of any protrusions reducing the potential for cable damage during installation. The bottom of the trough shall have holes to prevent water/frost build-up.

b. The cable trough shall be drilled in the bottom for transition to conduits for cable installation. All cable between trough and equipment shall be installed in conduit.

3.04 FIELD QUALITY CONTROL:

A. Demonstrate capability and compliance with requirements upon completion of installation of trough and utility structures.

B. Correct installations where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.05 CLEANING:

A. Clean internal surfaces of trough.

B. Remove foreign material.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Cable trough will be measured by the linear foot, installed in place complete with covers and all associated parts and materials including handholes.

4.02 PAYMENT:

A. Cable trough will be paid at the contract unit price per foot for each foot of cable trough installed in place.

END OF SECTION

SECTION 17142

WHEEL DETECTORS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to design furnish and install wheel detectors and their ancillary equipment in the MTA CLRL North Avenue Yard.

1.02 QUALITY ASSURANCE:

A. Factory test all wheel detectors in accordance with approved procedures as specified in Section 17251.

B. Field test all mainline track circuits in accordance with approved procedures as specified in Section 17251.

1.02 SUBMITTALS: Unless otherwise specified all submittals shall be in accordance with Sections 01300.

A. Submit manufacturer's product literature, shop drawings and specifications of Wheel detectors for approval (CDRL).

B. Submit installation drawings for Wheel detectors (CDRL).

C. Submit as-built installation drawings for Wheel detectors (CDRL).

D. Submit installation, maintenance and operation manuals for Wheel detectors (CDRL).

E. Submit factory test procedures for Wheel detectors (CDRL).

F. Submit factory test reports for Wheel detectors (CDRL).

G. Submit field test/inspection procedures for Wheel detectors (CDRL).

H. Submit field test/inspection reports of for Wheel detectors (CDRL).

PART 2: PRODUCTS

2.01 GENERAL WHEEL DETECTOR REQUIREMENTS:

A. Wheel detectors shall perform the function of LRV/train detection.

B. Rail mounted wheel detectors shall be the two element sensor type capable of sending impulses via an amplifier to the wheel detector controller.

C. The wheel detector controller will have the capability of determining train direction and/or speed based on analysis of these impulses. The wheel detector controller will indicate track occupancy by energizing or de-energizing a relay.

D. A combination of wheel detectors will define a wheel detector zone. Wheel detector zones for the North Avenue Yard are as shown in the contract drawings.

E. There shall be 3 wheel detector zones for the south yard interlocking, one wheel detector zone for the north yard interlocking. In addition there shall be optional zones for the north interlocking tail track and each of storage tracks 6 to 13 as shown in the contract drawings and described in section 01110.

F. The wheel detector controller will have the capability of determining occupancy of a zone regardless of train direction.

G. Wheel detectors shall be compatible with the traction power negative return.

H. Restoration of power after a power failure shall not automatically restore wheel detectors to normal operation. The wheel detectors shall indicate track occupation until reset manually.

I. Manual reset of the wheel detector axle counts shall be available at the wheel detector controllers and shall have the ability to reset any controller to the actual number of axles occupying a particular zone. This feature shall be available at any time to correct the wheel count if an inaccurate count is identified in the general course of system operation or following power restoration.

J. Wheel detectors shall function properly in an uncontrolled temperature environment from –40 degrees F to 160 F.

L. EMI Requirements:

1. Wheel detectors shall be immune to EMI generated by the vehicle, the traction electrification system, the communications system, area power lines, the rail system environment, and any other electromagnetic noise.

2. Any form of EMI between adjacent wheel detectors on the same track or wheel detectors on adjacent tracks shall not affect safe operation or reliability of either wheel detector system.

2.02 WHEEL DETECTOR SUPPORTING EQUIPMENT:

A. In addition to the rail mounted detectors, the contractor shall provide all cabling, wiring, amplifiers, relays, wheel detector controllers, output relays and hardware necessary to provide a complete system.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Install wheel detectors in accordance with manufacturer's instructions and at locations and in accordance with the Bid Documents.

B. Cabling for wheel detectors shall be with two twisted pair shielded cable from the wayside installation to the CIH and specified in Section 17221. Wheel detector cabling on the wayside shall be properly tagged and labeled.

C. The contractor shall participate in a joint inspection with the Administration to finalize the location of each wheel detector.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Rail mounted wheel detectors will be measured on a unit price basis installed in place complete with all hardware and accessories described herein, and cable.

B. Wheel detector controllers and output relays will measured on a unit price basis installed in place complete with all associated wiring and connections

4.02 PAYMENT:

A. Wheel detectors will be paid at the contract unit price for each new wheel detector installed in place.

B. Wheel detector controllers and output relays will be paid at the contract unit price for each new controller and output relay installed in place

END OF SECTION

MARYLAND TRANSIT ADMINISTRATION

MARYLAND DEPARTMENT OF TRANSPORTATION
Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
James T. Smith, Jr., Secretary • Robert L. Smith, Administrator

TO: All Planholders

FROM: Maryland Transit Administration

SUBJECT: **ADDENDUM NO. 2**
Contract No.: T-0451-0240
NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM

DATE: September 17, 2013

Enclosed and effective this date is Addendum No.2 to the subject Contract. This change does not delay the Bid Opening Date of October 23, 2013. The MBE goal percentage for this contract has been added. Also, instructions on how to obtain the drawings have been revised per this addendum.

The Bidder shall acknowledge receipt of this Addendum by completing and returning this form with the bid package.

All other terms and conditions remain unchanged.

Sincerely,

Joseph B Johnson
Joseph B Johnson, Procurement Officer
Professional Services/Construction/Installation Section
Procurement Division

Acknowledgement of receipt of ADDENDUM # 2 to Solicitation #T-0451-0240

Vendor Name: _____

_____ _____
Authorized Representative's Signature Date

ADDENDUM NO.: 2
DATE: 09/17/13
CONTRACT NO.: T-0451-0240

The following additions, deletions, and modifications are hereby made a part of the Contract Documents of NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM, Contract No.: T-0451-0240.

Item No.	Page	Modification
I. CONTRACT SPECIAL PROVISIONS		
1	Page 1 of 6 Notice to Contractor	**Revised** – The MBE percentage goal has been added to the this contract
2	Page 1 of 6 Notice to Contractor	**Revised** - Please be advised that a copy of the drawings can be obtained by e-mail request via e-mail to: **jjohnson14@mta.maryland.gov**

Also attached are the answers to contractors' questions, if any.

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMINISTRATION
NOTICE TO CONTRACTORS

CONTRACT TITLE: NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM

CONTRACT NO.: T-0451-0240 **DATE:** September 9, 2013

1. DESCRIPTION OF WORK

A. This project is for the design, furnish, test and place in service a pushbutton routing system at the Light Rail North Avenue Yard.

B. Estimated value for this work is in the range of $2,500,001 to $5,000,000

2. PRE-BID MEETING & SITE VISIT

A Pre-Bid meeting for the purpose of explaining the Project will be held on **September 19, 2013 at 10:30 a.m.**, local time at the Administration Headquarters, 6 St. Paul Street, 7th Floor Conference Rooms 731-732, Baltimore, Maryland 21202-1614.

A Site Visit will be held on **September 19, 2013** immediately following the Pre-Bid Meeting. **OR** The site is accessible to the public and bidders can visit on their own.

It is strongly suggested that the person(s) responsible for the preparation of bid documents for bidders attend the Pre-Bid Meeting and the site visit. INSTRUCTIONS CRITICAL TO THE PREPARATION OF THE CONTRACT DOCUMENTS WILL BE PRESENTED AT THE PRE-BID MEETING.

3. DEADLINE FOR QUESTIONS

Questions regarding the work should be directed in writing to Mr. Joseph Johnson at the Administration Offices or via Internet address jjohnson14@mta.maryland.gov. No facsimile messages will be accepted unless accompanied by telephone notification at (410) 767-3363. Our fax number is (410) 333-4810. Questions directed to this office must be received no later than **October 2, 2013** at the close of the business day. Questions should be submitted on company letterhead. No interpretations other than written shall be binding on the Administration.

4. DUE DATE & TIME

Sealed Bids addressed to the Maryland Transit Administration, Contract Administration Department, 6 St. Paul Street, 7th Floor, Baltimore, Maryland

21202-6806, and marked "Bid for Contract No. T-0451-0240", will be received at the above address until but not after 2:00 P.M. local time **October 23, 2013**. At that time, the Bids will be publicly opened and read aloud at a location at the same address. Hand delivered bids should be deposited in the Bid Box located on the 7th Floor before the 2:00 P.M. deadline.

Any bids received after the date and time specified shall not be considered.

5. ELECTRONIC VERSION OF BID DOCUMENTS

The bid documents will be available by electronic means. The Bidder acknowledges and accepts full responsibility to ensure that the Bidder has made no changes to the Administration's bid documents. In the event of a conflict between the version of the bid documents in the bidder's possession and the version maintained by the Procurement Officer, the version maintained by the Procurement Officer shall govern.

6. AVAILABILITY OF DOCUMENTS

Specifications may be downloaded from the MTA web site located at www.mta.maryland.gov. Bidders will be required to log in the first time specifications are downloaded. This number should be used every time the bidder downloads the documents for this contract. Bidders must supply accurate information in order to receive notice of all subsequent addenda.

To obtain the specifications: Click on "Business", then "Procurement", then "Bids/Solicitation". All projects that are currently advertised will appear at the bottom of the page. You may then choose to download the specifications.

To obtain the drawings: Notify the MTA at jjohnson14@mta.maryland.gov submitting your company name, a contact person, a mailing address (not P.O. Box) and a phone number. A CD containing the drawings will be mailed after verification of the contractor information.

7. ADDENDA

Bidders are required to acknowledge all addenda with their bid package.

Although the MTA endeavors to send out all addenda to this solicitation in a timely manner, it is the responsibility of the contractors to make sure they received all appropriate documents prior to the bid due date.

8. EMARYLAND MARKETPLACE REGULATIONS

"e-Maryland Marketplace" is an electronic commerce system administered by the Maryland Department of General Services.

This means that all such information is immediately available to subscribers to e-Maryland Marketplace. Because of the instant access afforded by e-Maryland Marketplace, it is recommended that all Bidders interested in doing business with Maryland State agencies subscribe to e-Maryland Marketplace.

9. BID BOND

Each bid exceeding $100,000 must be accompanied by a Bid Bond in the amount of five percent (5%) of the Bid Price. Bid, payment, and performance security may be in the form of: (1) a bond executed by a surety company authorized to do business in the State; (2) a bond executed by an individual surety that meets certain criteria; (3) another form of security required by State or federal law; or (4) another form of security satisfactory to the unit awarding the contract. Sections 13-207, 13-216, 17-104 of the State Finance and Procurement Article, Annotated Code of Maryland.

10. PAYMENT AND PERFORMANCE BONDS

Payment and Performance Bonds in the amount of the Contract Price will be required by the awardee. Upon receiving notification of contract award, the Contractor shall deliver the bond to the MTA no later than the time the Contractor executes the contract. Bid, payment, and performance security may be in the form of: (1) a bond executed by a surety company authorized to do business in the State; (2) a bond executed by an individual surety that meets certain criteria; (3) another form of security required by State or federal law; or (4) another form of security satisfactory to the unit awarding the contract. Sections 13-207, 13-216, 17-104 of the State Finance and Procurement Article, Annotated Code of Maryland.

11. ELECTRONIC FUNDS TRANSFER

On every solicitation for a contract expected to exceed $200,000, the bidder will be required to accept payments by electronic funds transfer (EFT) unless the State Comptroller's Office grants an exemption.

12. MINORITY BUSINESS ENTERPRISE PROGRAM

A. **MINORITY BUSINESS ENTERPRISES ARE ENCOURAGED TO RESPOND TO THIS SOLICITATION NOTICE.**

B. The Maryland Transit Administration hereby notifies all bidders that, in regard to any Contract entered into pursuant to this advertisement, Minority

Business Enterprises will be afforded full opportunity to submit Bids in response to this Notice, and will not be subjected to discrimination on the basis of political or religious opinion or affiliation, race color, creed, sex, age or national origin in consideration for an award.

C. It is the goal of the Administration that Minority Business Enterprises participate in all Contracts. Each Contract will contain goals for Minority Business Enterprise participation on a contract-to-contract basis. A subcontracting goal of **twelve** percent **12%** of the total contract dollar amount has been established for this procurement. This dollar amount includes a sub goal of **seven** percent **7%** of the total contract dollar amount to be allocated to certified minority business enterprises classified as **Asian American**-owned businesses, and a sub goal of **four** percent **4%** of the total contract dollar amount to be allocated to certified minority business enterprises classified as African American-owned businesses. All bidders must submit with their bid a fully executed copy of the Certified MBE Utilization and Fair Solicitation Affidavit (MDOT MBE FORM A and MBE Participation Schedule (MDOT MBE FORM B). If the bidder fails to submit these completed forms with the bid as required, the procurement officer shall deem the bid non-responsive or shall determine that the offer is not reasonably susceptible of being selected for award. ALL MBE FIRMS MUST BE CERTIFIED BY THE MARYLAND DEPARTMENT OF TRANSPORTATION. NO OTHER CERTIFICATIONS WILL BE ACCEPTED.

D. **A contractor may count toward its MBE goal 60 percent of its expenditures for materials and supplies required under the contract and obtained from a MBE regular dealer, and 100 percent of such expenditures to a MBE manufacturer. The MBE credited supplies may not exceed 60 percent of the entire contract goal.**

E. New versions of Sections 13-103, 13-104 and 14-303 of the State Finance and Procurement Article of the Maryland Code, relating to increased bid/proposal documentation of MBE commitments, are effective as of October 1, 2004. The Contract under this solicitation will be awarded in accordance with these new requirements. As a result, new bid submission requirements, including certain revised MBE documents, are in effect for this solicitation. These new requirements are set forth elsewhere in this solicitation.

F. As a result of the revisions to Sections 13-103, 13-104 and 14-303, certain existing portions of the Code of Maryland Regulations (COMAR) relating to post bid submission of MBE subcontractors are inconsistent with the revised statute. To the extent the provisions of COMAR relating to post bid identification of MBE subcontractors are inconsistent with the requirements of this solicitation, the requirements of this solicitation shall control the award of a Contract. Questions or concerns regarding the MBE requirements

of this solicitation must be raised prior to the opening of bids or receipt of initial proposals

13. AFFIRMATIVE ACTION REQUIREMENTS

Bidders on this Work will be required to comply with MTA Affirmative Action Requirements and all applicable Equal Employment Opportunity Laws and Regulations.

14. FUNDING

This contract is funded with 100% state funds.

15. SUSPENSION AND DEBARRMENT CERTIFICATION

All bidders will be required to certify that they are not on the GSA List of Parties Excluded from Procurement and the List of Contractors Suspended or Debarred from Contracting with the State of Maryland. All bidders must also be in good standing with the State Assessment & Taxation Department.

16. CONTRACTOR'S QUESTIONNAIRE

All Bidders shall submit a fully executed copy the Contractor's Questionnaire Pre Award Evaluation Data Form with the bid package.

17. INSURANCE REQUIREMENTS

The Administration has chosen to provide Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective coverage on behalf of Contractors and subcontractors working on this project. This approach to project insurance is commonly called a wrap-up or owner controlled insurance program (OCIP). Specific information regarding Liability Insurance Requirements is contained in the Contract Specifications.

Please note that an Insurance Cost Worksheet must be included with each bid package.

18. USE OF BIDDER'S OWN FORCES

The bidder with his own forces shall perform not less than Fifty (50%) of the work at the project site.

19. BUY AMERICA REQUIREMENTS

This contract is subject to Section 165, "Buy America", of the Surface Transportation Assistant Act of 1982, U.S. Public Law 197-424, and regulations and/or guidance implementing this statutory provision issued by the Federal

Transit Administration of the U.S. Department of Transportation. The contract is further subject to the Buy American Steel requirements of Chapter 02 of subtitle 11 of the Code of Maryland Regulations, Title 21, State Procurement Regulations.

20. INVESTMENT ACTIVITIES IN IRAN ACT

State Finance & Procurement, §§17-701 – 17-707, Annotated Code of Maryland [Chapter 447, Laws of 2012].

> A company listed on the Investment Activities In Iran list is ineligible to bid on, submit a proposal for, or renew a contract for goods and services with a State agency or any public body of the State. Also ineligible are any parent, successor, subunit, direct or indirect subsidiary of, or any entity under common ownership or control of, any listed company.
>
> Agencies must obtain a certification regarding investments in Iran from each bidder or offeror for new contracts and from each contractor seeking to renew an existing contract. Specifically, bidders, offerors, and renewing contractors have to certify that at the time the bid/proposal is submitted or the contract renewed that the company is neither identified on the Investment Activities In Iran list nor engaging in investment activities in Iran.
>
> A company that cannot make the certification must supply the agency, under penalty of perjury, with a detailed written description of its investment activities in Iran.

False Certifications: If an agency, using credible information, determines that a company has submitted a false certification regarding its investments in Iran, the agency must notify the company and provide the company 90 days to demonstrate in writing that it is not engaged in investment activities in Iran. If the company fails to demonstrate that it is not engaged in investment activities in Iran in that time, the agency shall report the company to the Attorney General and to the Board of Public Works.

21. CANCELLATION OR REJECTION OF BIDS

Notice to Contractors may be canceled in accordance with State Procurement Regulations.

The Administration reserves the right to reject any and all bids and/or waive technical defects if, in its judgment, the interests of the Administration so require.

MARYLAND TRANSIT ADMINISTRATION
MARYLAND DEPARTMENT OF TRANSPORTATION
Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
James T. Smith, Jr., Secretary • Robert L. Smith, Administrator

TO: All Planholders

FROM: Maryland Transit Administration

SUBJECT: **ADDENDUM NO. 1**
Contract No.: T-0451-0140
NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM

DATE: September 13, 2013

Enclosed and effective this date is Addendum No.1 to the subject Contract. This change does not delay the Bid Opening Date of October 23, 2013. A copy of the Contract Special Provisions and Appendix A, B, C, D, E has been attached.

The Bidder shall acknowledge receipt of this Addendum by completing and returning this form with the bid package.

All other terms and conditions remain unchanged.

Sincerely,

Joseph B Johnson
Joseph B Johnson, Procurement Officer
Professional Services/Construction/Installation Section
Procurement Division

Acknowledgement of receipt of ADDENDUM # 1 to Solicitation #T-0451-0140

Vendor Name: _____

_____ _____
Authorized Representative's Signature Date

ADDENDUM NO.: 1
DATE: 09/13/13
CONTRACT NO.: T-0451-0240

The following additions, deletions, and modifications are hereby made a part of the Contract Documents of NORTH AVENUE YARD ROUTE PUSHBUTTON SYSTEM, Contract No.: T-0451-0240.

Item No.	Page	Modification
I. CONTRACT SPECIAL PROVISIONS		
1	Special Provisions Page No. SP-1 to SP-440	Contract Special Provisions have been attached to this addendum
II. APPENDIX		
1	Appendix A, B, C, D, E	Contract Appendices A, B, C, D, E have been attached to this addendum.

Also attached are the answers to contractors' questions, if any.

SECTION 01110

SUMMARY OF WORK

PART 1: GENERAL

1.01 DESCRIPTION:

A. The Central Light Rail North Avenue Yard is currently equipped with electrically powered switch machines that are activated by wayside pushbuttons adjacent to each switch machine. This requires the train operators to stop their trains at each switch and leave the train to operate the switch to the required position. To improve efficiency and personnel safety, MTA is going to add route pushbuttons that will set all switches in a route. The functions of the route pushbuttons will be controlled by a redundant non-vital PLC. To further enhance safety, train detection in the yard ladder tracks is also being added utilizing wheel detectors to prevent the possibility of any switch being thrown under a train.

B. The work in this Section, as part of Contract shall consist of the design, manufacture, documentation, delivery, storage, installation, demonstration, testing, interface requirements and placing into service a Non-Vital Route Request and Indication System for the Central Light Rail Line (CLRL) in the North Avenue yard. This includes the associated subsystems, equipment, materials, cables, hardware, and appurtenances, to provide a complete operating system as described herein. The Route Request and Indication system shall work in conjunction with existing electric switch machines and associated wayside control pushbuttons, relay based switch operating circuits and relay based switch indication circuits. Contractor shall furnish the management, labor, data, design, programming logic, testing, services, training, manuals, parts, materials, tools, systems, equipment, appurtenances, and incidentals necessary to complete the work in accordance with all Contract requirements. The Non-Vital Route Request and Indication System shall be installed in the North Avenue yard and existing 94 interlocking as shown in the Bid Documents.

C. The Contractor's operations shall conform to all applicable State and Local regulations.

D. Wherever these Special Provisions refer to the Administration, they shall be understood to mean the Maryland Transit Administration (MTA). Whenever reference is made to Engineer, it shall mean the Administration’s representative for the contract.

1. Submittals shall be made in accordance with Section 01300 Submittals.

E. All contractor personnel shall have the required Light Rail Railway Worker Protection Training along with valid MTA Contractor Badges. In addition, each work crew shall include at least one person who has been trained as an On-Site Coordinator.

1.02 CONTRACT DOCUMENTS: The work shall be performed in accordance with the following documents:

A. Volumes 1A and 1B (applicable to all portions of the work) - The General Provisions for Construction Contracts (GP's), issued by the State of Maryland Department of Transportation; the Supplementary General Provisions for Construction Contracts (SGP's) issued by the MTA; the Special Provisions (SPs) Sections (Divisions 1 through 17); the Notice to Contractors; the Liability Insurance Requirements; MTA Project Safety Plan; and the various forms and exhibits all issued by the Maryland Transit Administration of the State of Maryland Department of Transportation.

B. Volume 2 Drawings providing technical requirements and information relating to the work. The Contractor is not to regard these as design or construction documents.

C. All applicable codes, standards, and ordinances of Baltimore City and Baltimore County. Applicable sections of the Special Provisions contain references to Baltimore City or Baltimore County Standard Specifications. The Contractor is responsible for obtaining current copies of each referenced Standard prior to commencement of work.

D. The contract specifications and drawings are intended to present the minimum equipment requirements, typical circuits and typical installation arrangements. The Contractor's design shall be produced following these minimum requirements and typical arrangements and shall include all necessary details. Any variance from the minimum requirements or typical arrangements shall be identified in the submittal process. Variances shall be submitted for improvements to, or correction of, the minimum requirements and typical arrangements set forth in these documents CDRL). The Contractor shall be solely responsible for the final design. Contractor's design shall include but not be limited to the following:

1. Switch control and indication circuits and software.
2. Route control and indication circuits and software.
3. Pushbutton control circuits and software.
4. Axle counter circuits, controllers and software.
5. Interface circuits and software.

6. Power circuits.
7. Mechanical layouts.
8. Cable duct and trough layouts
9. Maintenance Control Panel layouts, controls and indications.
10. PLC application logic
11. Test plan, procedures and reports
12. Electrical and mechanical layout drawings for all of the above.
13. All other incidental design related to the scope of work.

1.03 DEFINITIONS:

The following definitions supplement those specified in the General Provisions.

Alignment: The horizontal and vertical location of track, street or highway as described by curves and tangents.

Assembly: A self contained or easily identified package, whose integrated parts, devices, and structure perform a discrete function.

Block: A length of track of defined limits, the use of which is governed by wayside and/or cab signals.

Bond, Rail Joint: A metallic connection attached to adjoining rails to ensure electrical conductivity.

Circuit, Double Wire: An electrical circuit not employing a common return wire but formed by individual wires throughout.

Civil Speed Limit: Maximum allowable speed with respect to the geometry of the track relating to curves and grades.

Clearance: Distance between fixed wayside structures and the dynamic outline of a moving vehicle.

Clearance Point: Location on a turnout or crossover at which required clearance is provided between vehicles on diverging tracks.

Conductor Bus: A conductor or group of conductors, terminated as a common connection for 2 or more circuits.

Conflicting Routes: Two or more routes, opposing, converging, or intersecting over which movements cannot be made simultaneously without possibility of collision.

Consist: The quantity and specific identity of LRVs coupled together.

Contractor: The term Contractor, when used in this Specification will reference the signal contractor. All other contractors will be as specified.

Derail: A device designed to cause a train/LRV to leave the rails.

Facing Point Switch: A track switch, the points of which face traffic approaching in the direction of the switch.

Failsafe: A characteristic of a system, which ensures any malfunction affecting safety will cause the system to revert to a state known to be safe.

Fail Soft: A failure in the performance of a system component that neither results in immediate of major interruption of the system operation.

Failure: The inability of a system, sub-system, assembly, or component to perform its required function.

Firmware: Programming that is inserted into read only memory, thus becoming a permanent part of a computing device.

Indication: A message from an individual field location to report its status to the supervisory control system.

Input: An electrical signal external to a system and recognized by it as valid information to be processed.

Interface: The points where 2 or more systems, subsystems, or contracts must meet to ensure continuity and proper operation.

Interlocking: An arrangement of apparatus in which various devices for controlling track switches, signals, and related appliances are so interconnected that their movements must succeed one another in a predetermined order, and for which interlocking rules are in effect.

Internal Point: A point whose state is determined by the states of input, or output points as defined by ladder logic or communications. The state may also depend on the states of other internal points.

Junction: A location where routes converge or diverge.

Locking: The electrical or mechanical establishment of a condition for a switch, interlocked route, speed limit, or automatic function which cannot be altered except by a prescribed and inviolate sequence of unlocking.

Local Control: Mode where an interlocking is controlled from a panel located at such location.

Mainline: Portion of track other than that designated as Yard or Storage.

Memory: A device that stores a program for the purpose of execution by a CPU.

Milestone: Contractual completion date determined by the number of days required to complete an item of work, added to the Notice to Proceed date, or a specified calendar completion date.

Module: A component of a microprocessor, which performs a specific function and is designed to be readily removable for the purpose of reconfiguration, expansion or repairs.

Non-Vital: Any function, which does not affect the safety of train/LRV operation.

Output: An electrical signal generated by a system, the state of which depends upon 1 or more of its inputs.

Point: A specified input, output, or specific internal state as defined by the program of a programmable controller, or microprocessor which is assigned to a specific electrical terminal.

Pre-conditioning: A function of switch control circuitry that calls for the switch to move to the opposite direction before electric locking is released.

Programmable Controller: A solid-state device, which senses electrical inputs and generates electrical outputs, such outputs being dependent upon such inputs as defined by changeable logic.

Relay: An electrical device designed to interpret input conditions in a prescribed manner and after specified conditions are met, to respond to cause contact operation or similar abrupt change in associated electric control circuits.

Scan Time: Total time required for a microprocessor to sense the state of its inputs, solve its equations, and change the state of its outputs.

Supervisor LRC: An individual who supervises, and interfaces with, the entire CLRL system from LRC.

Track Circuit: An electrical circuit, of which the rails of a track form a part, used to indicate the presence of a train/LRV.

Trailing Point Switch: A switch, the points of which face away from the approaching traffic.

Vital Circuit: Any circuit whose functions affect the safety of rail operations.

Wayside: Area between and adjacent to the tracks within the right-of-way.

Word: A grouping of data bits of specified length, which is used as a unit of measure of a memory.

1.04 ABBREVIATIONS: The following abbreviations supplement those in the General Provisions:

Abbreviation	Meaning
AAR	Association of American Railroads
AREMA	American Railway Engineering and Maintenance of Way Association
AC	Alternating Current
AF	Audio Frequency
Amp or A	Ampere
AH	Ampere Hour
ANSI	American National Standards Institute
APTA	American Public Transportation Association
ASTM	American Society For Testing And Materials
AWG	American Wire Gauge
BTU	British Thermal Unit
C	Celsius
CIH	Central Instrument Houses
CLRL	Central Light Rail Line
CMT	Cable Management Tray (Fiber Optics)
CP	Clearance Point
CPU	Central Processing Unit
CSE	Cable Slack Enclosure
CWI	Crossing Warning Indicator
DC	Direct Current
EA	Each
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
EEPROM	Electronically Erasable Programmable Read-Only Memory
EIA	Electronic Industries Association
EPT	Electrical Plastic Tubing
ERK	Emergency Restoration Kit (Fiber Optics)
F	Fahrenheit
FOC	Fiber Optic Cable
FOC-I-C	Fiber Optic Cable in Conduit
FRA	Federal Railroad Administration
FRE	Fiberglass Reinforced Epoxy
FS	Federal Specification
FT	Foot

GRS	Galvanized Rigid Steel
HSPF	Heating Season Performance Factor
Hz	Hertz
IEC	Institute of Electro-Technical Committee
IEEE	Institute of Electrical and Electronics Engineers
I/O	Input/Output
IJ	Insulated Joint
kWatt	Kilowatt
LED	Light Emitting Diode
LRC	Light Rail Control
LRV	Light Rail Vehicle
LS	Lump Sum
mA	Milliampere
MAS	Maximum Allowable Speed
MCM (kcmil)	Thousand Circular Mils
MIL – STD	Military Standard
MIL – HDBK	Military Handbook
MIN	Minimum or Minute
MNHR	Manhour
MO	Month
mph	miles per hour
mphps	miles per hour per second
mphpsps	miles per hour per second per second
MTA	Mass Transit Administration
MTBF	Mean Time Between Failures
MTSP	Maintenance Touch Screen Panel
MTTR	Mean Time to Restore
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
Nm	Nannometer
NTP	Notice to Proceed
NIC	Not In Contract
NVP	Non Vital Processor
OSHA	Occupational Safety and Health Administration
OSSP	Operational Signal Staging Plan
PB	Pushbutton
PCB	Printed Circuit Boards
PDR	Preliminary Design Review
PF	Power Frequency
PLC	Programmable Logic Controller
POS	Point of Switch
PROM	Programmable Read Only Memory
psi	Pound per Square Inch
PVC	Polyvinyl Chloride
RAM	Random Access Memory
RF	Radio Frequency

RFP	Request for Proposal
ROW	Right of Way
R,S&I	Rules, Standards and Instructions
SBD	Safe Braking Distance
SCADA	Supervisory Control and Data Acquisition
SEER	Seasonal Energy Efficiency Ratio
SHA	State Highway Administration
TPS or SS	Substation
TRACS	Traction Computer System
UL	Underwriters Laboratories
UMTA	Urban Mass Transit Administration
UV	Ultraviolet
UPS	Uninterruptible Power Supplies
V	Volts
VDC	Volts Direct Current
W	Watts
XLPE	Cross Linked Polyethylene

1.05 GENERAL SCOPE:

A. Description: Overall scope of work for the Non-Vital Route Request and Indication System project is to design, furnish and install a new Non-Vital Route Request and Indication System as well as new non-vital interlockings encompassing the North and South interlocking in the North Avenue yard and interfacing with 94N interlocking. This system shall provide detection of trains in the project area using wheel detectors. The wheel detectors shall be installed in accordance with the project drawings. Design, furnish and install normal and standby PLCs in south CIH. These new PLCs shall be capable of operating North interlocking, the combined South and 94 interlockings as two distinct interlockings. I/O for each of these CIHs shall be linked by fiber optic cable.

B. The project effort shall occur in the following areas:

1. North CIH:

2. South CIH:

3. 94N CIH

4. Yard Lead Tracks (adjacent to 94N interlocking)

5. Yard Tracks 1 thru 13 (south end of yard)

6. Yard Tracks 1 thru 13 (north end of yard)

7. Yard Tail Track

8. Existing yard switch pushbuttons

C. Optional Zones 5 thru 13:
As an additional option, the Contractor shall provide Zone 5 thru 13 for the north tail track and the storage tracks between the North and South portions of the yard. These zones shall utilize the same wheel detectors as used for Zones 1 thru 4.

1. Zones 5 thru 13 shall have the following capabilities:

   a. Detect train occupation of the north tail track and tracks 6 through 13 regardless of direction
   b. Determine the number of axles currently in a particular zone.
   c. Record the number of axles currently in a particular zone.

2. Any route shall be allowed into any of these zones irrespective of the existing state of occupancy.

3. The cost of providing this option shall be provided by the Contractor separate from the project cost.

Note to Bidders:

Existing, as-built drawings of the existing MTA Light Rail signaling facilities in the North Avenue Yard and at Location 94N are available as AutoCAD DWG files. CAD files for any contract drawings can be made available to the Contractor, but the Contractor will be responsible for validating all dimensions and layout configurations shown on these drawings.

1.06 GENERAL FEATURES:

A. Systems shall provide the functions of train detection, safe vehicle separation and route security through the yard interlockings as specified herein.

B. System control equipment shall be located along the track only where necessary. All other equipment shall be located in Central Instrument Houses (CIH) or wayside cases.

1. Apparatus typically located along the tracks includes the following:

   a. Interlockings:

      1. Wayside Pushbutton assemblies

2. Wheel detectors

3. Cable trough

4. Handholes

5. Conduit

6. Cabling

7. Wayside Instrument Cases

8. Junction Boxes

2. Apparatus located in interlocking and signal housings include:

a. Programmable logic controllers (PLC)

b. Wheel detector/Axle counter amplifiers, controllers and relays.

c. PLC I/O modules

d. Vital and Non-Vital relays and hardware

e. Interlocking control logic circuitry.

f. Maintenance panel touch screens

g. Power equipment.

1.07 REQUIREMENTS OF NON-VITAL ROUTE REQUEST AND INDICATION SYSTEM:

A. The Non-Vital Route Request and Indication System shall perform the function of two distinct interlocking systems. The Non-Vital Route Request and Indication System shall:

1. Establish and cancel the routes of trains by the use of route pushbuttons in the north and south areas of the yard.

2. Indicate a route has been selected by a flashing indication light next to the pushbutton. When the indication light is illuminated steady, this will indicate the route has been lined and detected in the requested position.

3. Establish and cancel the routes of trains by the use of a Maintenance Touch Screen Panel (MTSP) in the north or south

CIH in the north and south areas of the yard. Controls shall enable complete routes or individual switches to be selected or cancelled. MTSPs shall also display route status indications, switch position indications and track occupancy status.

4. Operate yard switches from the existing yard switch pushbuttons in the north and south areas of the yard.

5. Detect the presence, on any portion of the track, of an LRV or track maintenance equipment.

6. Prevent conflicting routes.

7. Control direction of LRVs on a given section track.

8. Provide independent operation of the north and south interlockings

1.08 SYSTEM OPERATION:

A. The North interlocking, the combined South and 94N interlockings shall each have 3 modes of operation:

1. Route Pushbutton Operation:

Route Pushbutton operation shall be enacted from the maintenance touch screen panel and shall be the primary method of operation in the yard.

In route pushbutton operation, train operators may select routes from any of the wayside pushbutton panels in the yard. Pushbutton route selections may occur in the South or North portion of the yard independent of each other. However, only one route selection may be made at a time in the North portion of the yard and a maximum of three non-conflicting selections may be made at a time in the South portion of the yard. Pushbutton panels will have pushbuttons and indication lamps identified for each available exit track.

- Before a selection for a track is made, indication lamps will be dark.
- If a route is not available because a conflicting route has been established and/or a train is occupying any portion of the route, the indication lamp shall flash to indicate that the route request has been received by the PLC but cannot be implemented.
- When a route is available, the indication lamp corresponding to the selected pushbutton shall flash while

any switch in the selected route is out of correspondence with the required position.

- When all switches in the route selected have been lined and detected in the requested position, the indication lamp will illuminate steady, telling the operator it is safe to proceed.

A cancel pushbutton will also be provided at each pushbutton panel. Should the train operator wish to cancel a selection already established, the cancel pushbutton will cancel the existing route. When the cancel pushbutton is used, the steadily illuminated indication lamp will be extinguished. After this occurs, the train operator may select another available route. A single Cancel pushbutton shall cancel all routes available from that panel.

a. Train movements into and out of the MOW storage track: Train movements into and out of this track will require the use of a key switch. This key switch must be operated before the route selection can occur. While the key is turned, the pushbutton selection may proceed. No moves into or out of the MOW storage track will occur successfully without the use of the key switch.

2. Maintenance Touch Screen Panels:

Maintenance Touch Screen Panels shall be located in the south and north yard CIHs. The maintenance touch screen panels shall both display a schematic of the entire north and south yards including the scissors crossover at 94N interlocking. Icons resembling pushbuttons shall be displayed at each potential entrance track and will initiate alignment of the desired route when the screen is touched. When this occurs, the affected route shall flash as well as an indication icon for the particular route. When the route is lined and detected in the requested position, the display shall change to reflect the change in switch position and indicate the route is lined and detected in the requested position by changing the color of the route to illuminate steady white. In addition, the indication icon for the particular route shall illuminate steady. When a train occupies the route, the route indications shall change from white to red.

MTSP icons shall be operated through the use of drop down menus indicating all of the operations to be performed at the pushbutton or switch. These menus shall include but not be limited to the functions of select, cancel, normal, reverse, exit, as applicable to route or switch functions

The maintenance touch screen panels shall display icons at all switch locations in the yard schematic. These icons shall be used to operate the switches in the yard individually for test purposes. Their operation shall be similar to a unit lever operation. When operated the display shall indicate switch operation by flashing the image of the switch. When the switch attains correspondence, the image of the switch shall appear solid in the direction requested. Modes of operation, i.e. route pushbutton, MTSP, and LRC (future) and existing yard switch pushbuttons will be selected by touching corresponding icons on the MTSP. Switching between modes of operation shall retain a previously selected route. For the controls and indications of the MTSP, refer to specification section 17175.

a. MTSP Operation Restrictions:

1. Both MTSP panels as well as the LCP at 94N interlocking cannot be operated at the same time. The MTSP in the South CIH shall have priority for MTSP operation of the South Yard Interlocking, the MTSP in the North CIH shall have priority for MTSP operation of the North Yard Interlocking and the Existing 94N LCP shall have priority for the 94N interlocking followed by the South Yard MTSP and lastly the North Yard MTSP.

2. Selection of a mode of operation from an MTSP shall inhibit the operation of the remaining modes for that particular MTSP but not the other.

3. Selecting a southward pushbutton route at 94 interlocking shall not be inhibited if the MTSP panel at south interlocking is in operation.

4. Track and /or switch blocking initiated from an MTSP shall only be released from that MTSP.

3. Existing yard switch pushbutton operation will be enacted from the maintenance touch screen panel and shall be used for switch testing purposes only. During this operation, switches in the yard may only be operated from the switch pushbuttons located adjacent to each individual switch movement in the yard. When this mode is in effect, switches shall be operated directly from the adjacent pushbuttons without intervention from the interlocking or detector locking protection.

4. LRC Control (future)
   a. Allow for future operation of the Yard interlockings via a network connection to the Light rail Control Center. Functionality shall be the same as described for the MTSPs.

1.09 SCOPE OF WORK:

A: In addition to the General Scope, the scope of work for this contract shall be as follows:

1. All work shall be in accordance with these Specifications.

2. Contractor shall furnish, install and test new wayside pushbutton assemblies where indicated in the contract documents. Existing pushbuttons at 94-2, 94-4 shall remain in place but the pushbutton and indication devices shall be replaced with the same devices used in all the new pushbutton panels.. Existing pushbuttons at 94-6, 94-8 shall be upgraded and renamed as shown in the contract documents. This shall include but not be limited to the pushbutton enclosures, pushbuttons, indication lamps, cabling terminal boards, wiring, cabling detectors, junction boxes, cabling, interface relays, foundations, masts, mast bases, hardware, and all appurtenances required to provide a complete system.

3. Contractor shall furnish, install and test, wheel detectors in accordance with the contract documents. This shall include but not be limited to the rail mounted wheel detectors, junction boxes, cabling, amplifiers, wheel detector controllers, relays, hardware, and all appurtenances required to provide a complete system and interface the detection section statuses with the PLC.

4. Contractor shall furnish, install, and test separate normal and standby non-vital Programmable Logic Controllers (PLCs) in the south CIH.

   a. The normal PLC shall be the primary controller and perform all of the logic and processing necessary to maintain yard operation as described in the contract documents. The normal processor shall interface to other subsystems, i.e., the I/O modules, the MTSP, fiber optic links to the LRC and other adjacent CIHs.

   b. The standby PLC shall be the secondary controller; perform all of the functions and interface to all of the subsystems as the primary controller. The standby PLC shall share the

same I/O as the normal PLC.

c. In the event of a PLC failure, PLCs shall have the ability to switch between normal and standby without loss of functionality in any operating mode.

d. The PLCs shall have the ability to be switched between normal and standby manually without loss of functionality in any operating mode.

e. The redundant PLC shall be powered from three independent power supplies; one for the normal PLC, one for the stand-by PLC and one for the I/O modules.

5. Contractor shall provide remote I/O modules as necessary in the North CIH and the 94N CIH. Connect the North CIH I/O, South CIH PLCs and 94N CIH I/O with 12 strand fiber optic cables configured in a closed ring such that if any one element of the ring is broken, all communication is maintained through the remaining segments of the ring.

6. Power for all equipment in the North, South and 94N CIHs shall be derived from existing power buses in each CIH. Contractor shall provide all necessary circuit breakers, fuses, wire, transformers, power supplies, surge suppressors, terminals and any other required components to interface all new equipment with the existing power distribution systems.

7. Contractor shall provide all interfacing circuits and revisions to existing circuits in accordance with the contract documents to ensure the Non-Vital Route Request and Indication System for the North CIH and South CIH as well as existing 94 CIH operate as a complete system

   a. Interface circuits for LRC shall be provided in accordance with the Bid Documents. This shall include fiber optic cabling to the LRC and all hardware necessary to provide control and indication of the Non-Vital Route Request and Indication System to LRC. It shall be the responsibility of the Contractor to coordinate with the Administration to guarantee that the interface signaling equipment has the appropriate communications protocol with existing and/or new Light Rail Control equipment

8. Submittals:

   a. Contractor shall submit all information required by these Specifications. It shall include all design drawings and documents, samples, test plans, test procedures and test

results submitted in the approved order.

b. Signal drawings shall be submitted as specified in Section 01300. It shall be the responsibility of Contractor to complete the design for this system and provide a complete set of Working Drawings. This shall include complete details of all equipment, circuits, and their physical layouts, all in accordance with established fail-safe signaling and train control practices. All design drawings shall be sealed by a registered professional engineer registered in Maryland. Cad files for all contract drawings will be made available to the Contractor.

c. In addition to shop drawings and product submittals, Contractor shall submit systems drawings for a Preliminary Design Review (PDR) (CDRL) and Final Design Review (FDR) (CDRL) and shall participate with the Administration in design review meetings. Following successful system test, Contractor shall submit as-built versions of all drawings, including pdf and original CAD electronic files and electronic copies of all PLC software. All drawings shall compliment and supplement existing drawings. Existing drawings shall be revised where necessary.

9. Products and Materials: Contractor shall furnish, unless otherwise specified in the Contract, all material, implements, machinery, equipment, tools, supplies, transportation, and temporary utilities necessary for the execution and completion of the work.

a. Contractor shall supply all documentation and spare parts, and provide training as specified in Section 17271. Contractor shall provide a signal engineer and other personnel necessary as approved by the Administration to support operations and safety certification as specified in these Bid Documents.

10. Design: Contractor's design shall be consistent with the principles and practices depicted in the contract typical drawings. System drawings shall include but not be limited to the following:

a. System Design: Provide system design as required, operational descriptions and all other system type designs that depict system operational requirements.

b. Product Design: Provide detail design, circuits, drawings, test results and documentation of necessary components, and subsystems in conformance will all requirements specified in these Specifications.

c. Circuit Design: Provide the circuitry, detail design, testing, circuit check and drawings in conformance with all requirements specified in these Specifications.

d. Software Design: Provide all of the programming for the PLCs necessary to furnish a complete system. Including but not limited to interface between PLCs, new and existing I/O, and communications in conformance with all requirements specified in these Specifications.

e. Installation Design: Provide complete electrical and mechanical design and drawings for installation of all required equipment in conformance with requirements of these Specifications.

11. Testing:

a. All testing shall be done in accordance with the contract documents.

b. Factory Acceptance Testing: It shall be the responsibility of the Contractor to perform factory acceptance testing of all PLCs, Wheel detectors, pushbutton assemblies and their supporting equipment. It shall be the requirement of the Contractor to do complete system testing of all equipment used or interfaced with existing CIHs or intermediate cases. Contractor shall develop a Factory Acceptance Testing procedure and submit to the Administration for approval (CDRL).

c. Field Testing: Contractor shall obtain approval for the test plan and procedures as set forth in these Specifications prior to start of field testing. Contractor shall successfully complete all tests necessary to ensure the Non-Vital Route Request and Indication System operate according to these Specifications.

12. Trackside Equipment Clearance:

a. Installation of signaling equipment in the North Avenue Yard shall be in accordance with CLRL clearances.

1.10 PRELIMINARY SIGNALING SYSTEM CIVIL WORK:

A. Non-Vital Route Request and Indication System: It shall be responsibility of the Contractor to furnish and install the civil infrastructure. This will permit the Contractor to install signal cables and wayside equipment without major excavation of the track and right of way. Civil items to be installed, but not limited to, are as follows:

1. Route pushbutton foundations.

2. Handholes and interconnecting conduit system to connect wayside devices to new and existing cable trough system.

3. Cable trough as shown on the contract drawings to supplement the existing cable trough network.

4. Grading of equipment area.

B. It shall be the Contractors responsibility to furnish and install the civil infrastructure to support the new signaling system at the following locations:

1. New Pushbutton assemblies.

2. Handholes and conduits.

3. Wheel detectors

4. Junction boxes

5. Cable trough

1.11 RETIRING AND REMOVAL OF EXISTING SIGNAL EQUIPMENT:

A. Contractor shall retire and remove only the existing signaling equipment indicated on the contract drawings. All retired equipment shall be returned to MTA. The storage location of retired signaling equipment will be furnished by the Administration. These items include but are not limited to:

1. Relays and bases.
2. Wayside Pushbutton assemblies.
3. Equipment Padlocks.

B. Contractor shall be responsible for the removal of existing equipment foundations.

1.12 STAGING:

A. The Non-Vital Route Request and Indication System is scheduled to occur over a 15 month period. During this period, interim staging of existing and new signaling equipment shall be required. It shall be the responsibility of the Contractor to submit a Staging Plan (CDRL) and provide all necessary manpower and equipment to meet the needs of temporary and final signaling transitions. Contractor's work shall consist of, but not limited to, the following:

B. Design, install and test interim signaling circuits.

C. Design, install and test interim interface signaling circuits.

D. Furnish, install and test interim signaling equipment.

E. Furnish, install and test temporary signaling cables.

F. Provide, up to date circuit plans that reflect all interim changes.

G. Provide operations descriptions for all interim operating situations.

H. Provide on-site assistance in event of signaling system failures during interim operations.

PLANS, SCHEDULES, REVIEWS, DOCUMENTATION, WARRANTY, TRAINING, ETC.

A. PROJECT MILESTONES

The following project milestones shall be completed based on the contractor's project schedule (P/S) accepted by the Administration as follows:

Milestones In Calendar Days			
		Completion From Contract NTP	**Administration Review Period**
	Project Specific Safety and Health Plan	5 Days	21 Days
	Plans and Schedule Contract Data Requirements List Project Management Plan QA/QC Plan Migration Plan Project Schedule	10 Days	21 Days
	Preliminary Design Review	30 Days	21 Days
	Final Design Review	90 Days	21 Days
	Training Program	120 Days	28 Days
	Operating Documentation	210 Days	28 Days
	Factory Acceptance Test	180 Days	21 Days
	Field Installation Acceptance Test	360 Days	21 Days
	Thirty Day Operational Test	390 Days	21 Days
	Project Completion except Software Upgrades and Warranty	450 Days	30 Days
	Software Upgrades	30DOT plus 180 Days	21 Days
	Warranty	FIAT plus 365 Days	30 Days

B. PROJECT MIGRATION PLAN AND PROJECT SCHEDULE

1. Contractor shall utilize a well-defined methodology to manage the life cycle of activities needed to complete this project. Contractor shall keep the Administration involved throughout the project life cycle so as to minimize the risks associated with misunderstanding the detailed requirements.

2. Within thirty (10) days after receipt by the contractor of the Notice to Proceed, the Contractor shall deliver the Project Migration Plan and Project Baseline Schedule. Detailed PERT charts, with the critical path identified (using CPM), showing when tasks occur, when resources are required, and what tasks dependencies exist shall also be included as detailed in Section 01300. The Project Migration Plan and Project Schedule shall be of sufficient detail and clarity so that the work can be controlled and the administration can monitor progress during the life of the project. The charts shall indicate a logical sequence of work and identify all dependencies, personnel resources, material, equipment, and work areas required for completion of the work. The degree of detail shall be sufficient to identify at a minimum:

   a. Major contract phases, milestones and deliverables as specified both within the contractors' system development and installation methodology and those specifically identified throughout the contract documents.

   b. Project events with associated tasks and sub-tasks.

   c. Interfaces and dependencies with preceding, concurrent, and succeeding work effort.

   d. Resources needed and assignments down to other task levels for staff, material, work site and equipment.

3. Contractor shall deliver the Yard Route Pushbutton System consistent with the approved Project Migration Plan and Project Schedule. Changes to the milestone completion dates must be approved by the Administration in advance. Subject to such approval, the Contractor must ensure that the Project Schedule/Migration Plan contains any changes, updates or new information related to the project's status, or any other requirement, deliverable or feature related to the performance of the Yard Route Pushbutton System different from the information which the contractor included in its design. The Migration Plan will be revised to reflect revised approved schedule.

4. The Project Schedule shall be updated per Section 01300, to reflect current status and shall be delivered to the Administration not less than two days prior to regularly scheduled project progress meetings. At these progress meetings the Contractor must advise the Administration of any project slippage, deliverable delay, change in project organization, or program.

C. SYSTEMS DESIGNS

Contractor shall complete the Systems Design in two phases. The Preliminary Design shall culminate with a Preliminary Design Review (PDR) which shall consist of a 70% Systems Design and be submitted in accordance with the Project Schedule (CDRL). The Final Design shall culminate with a Final Design Review (FDR) which shall consist of a 100% Systems Design and shall also be submitted by the Contractor in accordance with the Project Schedule (CDRL). The Systems Final Design must be approved by the Administration prior to the start of any manufacturing, installation or construction work, unless specifically pre-approved by the Administration.

1. Preliminary Design

The Preliminary Design shall include the following features:

a. Contractor shall provide a Preliminary Design, which shall provide the features, functions and technical specifications of the system at 70% completion level. The design documentation provided shall include the documentation as provided in section System Design Documentation.

b. In the course of completing the Preliminary design, the Contractor shall obtain the necessary user input on key open design questions that the Contractor may have, and conduct site visits to confirm the operation of the existing systems and equipment and collect data necessary to assist the Contractor in completing the Preliminary Design.

c. The Contractor shall schedule, at a minimum, monthly Preliminary Design progress meetings with the Administration.

d. The Preliminary Design life-cycle shall proceed in the following sequence and include:

i. Progress Meetings

ii. Issue Preliminary Design documents

iii. Completed PDR review session with the Administration

iv. Administration internal PDR

v. Administration comments to Contractor

vi. Comment review and approval to commence Final Design

2. Final Design Review (FDR) - 100% Systems Design

Contractor shall provide a Final Design subsequent to review and approval of PDR by the Administration, which shall provide the features, functions and detailed technical specifications of the system at 100%

complete level. The final design documentation provided shall include the documentation as provided in section System Design Documentation.

a. The Final Design life-cycle shall proceed in the following sequence and include:

i. Progress Meetings

ii. Issue Final Design documents

iii. Completed final design review session with the Administration

iv. Administration internal FDR

v. Administration comments to Contractor

vi. Comment review and updated Final Design documents

vii. Approval of Final Design Documents by the Administration

D. SYSTEMS DESIGN DOCUMENTATION

Systems Design Documentation shall be provided to the Administration in accordance with the approved project schedule and migration plan. At minimum, the design shall contain the following:

1. Systems Documentation

a. Executive Summary: a summary of documentation material provided in all deliverables, an overview of the entire system describing all major components (System and sub –Systems) of the Yard Route Pushbutton System, and special features of the Yard Route Pushbutton System which address performance, expansion, system security, ease of use, and maintainability.

b. System Architecture: a system-level graphic representative of all hardware components and their interconnections. This shall include identification of the interfaces between all existing and proposed devices and systems.

c. System Processing Narratives: detailed narrative descriptions of each major processing activity to be performed by the Yard Route Pushbutton System. The narratives should describe how all equipment and software interacts to satisfy the functional requirements of the Yard Route Pushbutton System. These narratives shall be clear and comprehensive explanation of how each of the Administration's functional requirements is supported by the Yard Route Pushbutton System.

d. Security Features: a description of all system security features, computer controlled and physical, designed into the Yard Route

Pushbutton System to control and monitor the systems and its components. In addition, describe all features, components and equipment which protects the Yard Route Pushbutton System from physical hazards such as electrical power surges, brown-outs and black-outs.

e. Failure Handling and Recovery: a failure/recovery matrix showing the types of failures, the process of reporting these failures and if automatic or semiautomatic. This shall include descriptions of system diagnostics to detect and isolate failures.

2. Computer and Field Equipment Software Documentation

a. Software Architecture: system level illustrations, such as flowcharts and block diagrams. Illustrating the overall structure of the Yard Route Pushbutton System systems. These diagrams shall include the major processing functions performed by each subsystem or major module, their interaction with each other and with the Yard Route Pushbutton System users.

b. Software Configuration: a description of the operating system, application, database/data management, utility, graphical user interface, device drivers and any other software used in the Yard Route Pushbutton System. Contractor shall identify which software is to be custom developed and which is third party software. For third party, the Contractor shall explain the functions to be performed by the product and identify the manufacturer, version and release to be used and shall submit all technical specifications and literature (CDRL). For custom software the Contractor shall identify the languages, compliers, and utilities to be used in development and operation.

c. Database and Data Management Structure: a description of the overall organization of the files and/or database to be used in the Yard Route Pushbutton System. This description shall include, but not limited to, full details regarding any third party database products including version, release, functional characteristics, operational requirements, and any other relevant characteristics of the products.

d. Data Dictionary: a listing of all Yard Route Pushbutton System data elements, including the size, definition, validation rules and other information pertaining to the elements. If a commercially available data dictionary is to be used the Contractor shall also submit complete and current information about the product (CDRL).

e. Data Storage Analysis: the techniques employed to ensure that the Yard Route Pushbutton System can meet the storage requirements for on-line and historical data, and expansion capabilities. The analysis shall include identification of all files, databases and their retention cycles.

f. Operator Interface: Describe the operator and user tools and techniques employed to ensure an easy to use, consistent and efficient interface between the operator and the Yard Route Pushbutton System. Include all operator screens and icons including

the configuration/state of each icon for each equipment state.

g. Program and Module: Narrative description of major program modules contained in the Yard Route Pushbutton System and the description of the processing functions, inputs and outputs of these modules.

h. Detailed Software Design: block diagrams, flow charts and/or other software design documentation that describe the design of the Yard Route Pushbutton System software by major subsystems. This information shall include the details of main processing functions performed by each program or module, including inputs, outputs and data type definitions.

i. Inputs and Outputs: a description of all Yard Route Pushbutton System inputs and outputs. Inputs and Outputs to be received/sent by the operator shall include descriptions of all transactions, messages, records, signals, screens, reports, and menus. Contractor shall provide the documentation for field structures of messages and records and the methodology for redefining menu structures.

3. Hardware Documentation

a. Hardware Specifications: a full bill-of-material and complete specifications for each hardware element of the Yard Route Pushbutton System. Hardware specifications must include an expansion of equipment functionally and theory of operation.

b. Component Drawings: drawings that clearly and completely indicate the function of each Yard Route Pushbutton System hardware component. The drawings shall indicate termination points of devices and interconnection required for system operation, interconnection between modules and devices, spacing of components and location, mounting and positioning details.

4. Field Equipment Documentation

a. Hardware Specifications: a full bill-of-material and complete specifications for each field element of the Yard Route Pushbutton System. Equipment specifications must include an expansion of equipment functionally and theory of operation.

b. Component Drawings: drawings that clearly and completely indicate the function of each Yard Route Pushbutton System equipment element. The drawings shall indicate termination points of devices and interconnection required for system operation, interconnection between modules and devices, spacing of components and location, mounting and positioning details.

c. Detailed conduit and cable drawings (end-to-end), schedules, including equipment locations, cable plans and wiring/termination diagrams. All cables and individual wires shall be uniquely identified. For any cables not conforming to a recognized standard, all conductors within the cable shall be uniquely identified.

5. System Operating Documentation

a. Contractor shall provide all documents, manuals, and printed materials necessary for the effective operation of the Yard Route Pushbutton System systems. The documents provided shall be in bound copies and also provided in an electronic version as described in the Specification Section "Submittals". This documentation shall include, but not be limited to the following specific manuals:

i. Standard Operations Procedures Manual: This manual shall be provided to include graphical depictions and explanations of the system operation for all operator functions. This manual shall be for instructional, study, and refresher use and shall explain all features and functions of the Yard Route Pushbutton System systems for day-to-day operations. The manual shall also have a section on problems and/or exception conditions so operators can resolve common operating problems. The manual shall also contain instructions on how to perform normal maintenance. This Manual shall be submitted for approval (CDRL).

ii. Systems Administrator's Manual: This manual shall be provided to include graphical depictions and a written description of all functions required for software modifications and development. This manual shall contain all procedures necessary for the monitoring and administration of the Yard Route Pushbutton System systems. At a minimum, the manual shall contain separate sections for the following topics: Start up and shut down procedures, instructions for the cold start of the systems equipment, back-up and recovery, performance analysis, scheduled maintenance, user management, audit and control, report production, configuration control, system diagnostics, data base integrity, special requests, and expendable supplies. A separate removable section of the Yard Route Pushbutton System Administration Manual shall contain information on the proper administration and control of the security features built in to the Yard Route Pushbutton System. Some of the information in this section shall include maintenance of user identifiers, password control and security policy review. Information on appropriate review of security control for adherence through various types of reporting mechanisms and utilities and/or third party security software. This Manual shall be submitted for approval (CDRL).

iii. Supervisor's Manual: This manual shall be provided to include graphical descriptions of all functions and procedures required for system modifications specified under supervisor training. This manual shall contain all the instructions included in the Operator Procedure Manual plus instructions on printing standard and ad-hoc reports. This Manual shall be submitted for approval (CDRL).

iv. Refer also to Section 01301 for additional requirements for operations and maintenance manuals.

E. SEALING OF PROJECT DRAWINGS

All completed system design drawings developed for this contract by the contractor shall be sealed by a professional engineer registered in the state of Maryland prior to being issued for manufacturing or on-site construction. A PE seal will not be required on standard device or component drawings or on shop drawings if there is a sealed design drawing that covers the work shown on the shop drawing. As-built revisions of contractor developed sealed design drawings shall also be sealed by a Professional Engineer registered in the state of Maryland. The engineers who seal the drawings shall be involved throughout the design process as required by the regulations governing the conduct of professional engineers. As-built mark-ups of sealed Contract Drawings shall be submitted to the Engineer (CDRL).

F. SYSTEMS DEVELOPMENT

Contractor shall be required to integrate all system components into a fully functional system consistent with the requirements set forth herein or as may be approved pursuant to the RFP and approved FDR Systems Design, and consistent with the contract approved system document. Contractor shall complete the programming, parameterization and any tailoring needed to customize or otherwise modify commercial-off-the-shelf (COTS) products for the Administration. Contractor shall provide detailed “Change Control Procedures” for handling hardware and software upgrades to the Yard Route Pushbutton System after the approval of FDR. Contractor shall provide appropriate controls to ensure that the source code production load modules are synchronized in all versions and revisions at all facilities.

G. IMPLEMENTATION AND MIGRATION

Contractor shall be responsible for implementing the system design and integrating the Yard Route Pushbutton System with the existing system. Contractor is required to submit updates to the Migration Plan (CDRL), describing all activities and task associated with the installation and implementation of the system at the facilities. The Migration Plan submitted and approved concurrently with the PDR and FDR Systems Design submittals shall phase in migration from existing system to the new system. As part of the migration plan, Contractor shall provide documentation addressing equipment reliability projections, systems administration and procedural changes that will result from the migration to the new system

1. Installation

Contractor shall install hardware, infrastructure, communications equipment software and systems provided for under this contract in accordance with local building codes, National Fire Protection Association, the National Electrical Code and all other applicable standards and industry practices. Contractor shall furnish all labor, tools, cable conduit and supplies required to install all equipment and systems. Contractor shall remove and dispose of all debris at no additional costs to the Administration. The installation of any new equipment shall not

impact the existing equipment or communications networks. Power capacity for the system is available in each CIH. Power distribution, conditioning and any requirement for additional power will be at the Contractor's expense and subject to approval by the Administration. Contractor shall define their times and method of equipment delivery, which is subject to the Administration's review and approval.

2. Cutover to Yard Route Pushbutton System

Contractor shall cutover to the new system consistent with the Migration Plan which shall include at least the following tasks:

a. Install and test the new systems control equipment consisting of PLCs and maintenance control panels.

b. Provide documentation of all problems and corrective actions that occur while implementing the Yard Route Pushbutton System and create a historical database to be used in future development and/or changes to the Yard Route Pushbutton System.

c. After successful migration to the new systems and equipment, disconnect and remove all retired equipment

3. Removal of Existing Equipment and Material

a. All active equipment that is decommissioned shall be disconnected and removed.

b. Upon commencement of installation work, the Contractor shall make all efforts to complete the work in a minimum amount of time. In the event of slippage from those schedules, additional shifts as required, including Saturdays, Sundays and Holidays shall be scheduled to complete the work at no additional cost to the Administration.

c. The Migration Plan should also address periods of time/duration during the migration process when components of the existing Yard Route Pushbutton System may be taken out of service. Since scheduled interruption of the existing equipment should be known in advance of the event. Notice to the Administration for these interruptions shall be in accordance with the red tag requirements as specified in the contract. Scheduled interruptions must be kept to a minimum.

H. SYSTEM TESTING AND ACCEPTANCE

Contractor shall conduct a full program of testing, the purpose of which shall be to demonstrate to the Administration's satisfaction that the Yard Route Pushbutton System Project fulfils all specifications and requirements as set forth herein.

Note: The definition of a test plan shall consist of test plans and procedures which detail a description of the item to be tested, the inputs/outputs/expected results, test scenarios, test scripts, material and equipment required for execution of the test(s), an itemization and supplying of all special tools and devices needed

to perform the test, and the documentation of these details in a certified test report.

1. Pre-Acceptance Testing

   During the Yard Route Pushbutton System development phase and prior to the Contractor's submission of formal acceptance test plans and procedures the contractor shall test all material, equipment including software and hardware components individually and as an engineered system to ensure that they perform according to the specifications as set forth herein.

2. Acceptance Testing Plan

   Within 30 days of Final Design Documents approval or per the approved schedule, the Contractor shall prepare and deliver to the Administration for review and approval a comprehensive Acceptance Test Plan for all material and equipment, including software and hardware components, that describes all activities and tasks associated with testing during test phase, i.e., Factory, Field and Operational.

3. Acceptance Test Reports

   When all tests for a testing phase, test sub-plan or test plan/sub-plan have been executed to the satisfaction of the Administration, the Contractor shall prepare and deliver to the Administration an Acceptance Test Report along with the Contractor's written certification that the Yard Route Pushbutton System has successfully passed all tests for that specific test phase.

4. Factory Acceptance Test (FAT)

   All material and equipment including software and hardware components required to complete the Yard Route Pushbutton System project shall be inspected, by the Administration, at the Contractor's place of manufacture or development. Prior to the initiation of FAT, the Contractor shall provide final draft copies of all System Operating Documentation described herein.

5. Field Installation Acceptance Test (FIAT)

   After installation of the integrated system, and agreement by the Administration to initiate testing, the Yard Route Pushbutton System equipment and components shall be tested in compliance with the FIAT Plan.

6. Thirty Day Operational Test (30DOT)

   After Administration approval of the FIAT for all systems, stations and facilities, the Contractor shall begin the 30DOT. At that time, the Yard Route Pushbutton System equipment and components shall perform in

accordance with the approved 30 Day Operational Test Plan, under full operating conditions, for a period of thirty consecutive calendar days. Thirty Day Operational Test Plan shall address the operation of the overall integrated system. During the 30DOT, all subsystems will be fully functional and operational for 30 continuous days.

I. EXCHANGE AND EXPANSION EQUIPMENT DURING FACTORY, FIELD AND OPERATIONAL TESTING

Contractor shall certify in writing to the Administration when exchange or expansion equipment, devices, or components are installed and ready for use. For the purpose of this section, "expansion" is used to denote equipment which is not specified in the approved final design Bill of Materials. Contractor shall provide an Installation Date Certification for equipment or component. If this occurs during the 30DOT, the operational test shall recommence on the first Administration work day following acceptance of the Contractor's Installation Date Certification.

J. TRAINING

A Training Program shall be provided by the Contractor in order to provide initial and ongoing training for all users of the Administration Yard Route Pushbutton System.

1. Contractor shall develop and implement a training database configuration to train staff on the use of the integrated system. This training configuration should address the functions and operation of the Yard Route Pushbutton System Integrated, in real-time simulation of typical alarm events and responses.

2. Refer to Section 01301 for additional requirements.

K. WARRANTY

1. Warranty Service and/or Period

a. The warranty period shall be in accordance with the requirements of SGP 4.05 unless specifically identified to be longer in other sections of these specifications. The warranty period for each system at each station shall commence after the FAIT test results for that system at that location have been submitted and accepted by the Administration. The warranty period for the Yard Route Pushbutton System hardware shall commence when all the new hardware has been placed into service. During the Warranty Period, the Contractor shall provide Warranty Service on all equipment and software furnished under the Yard Route Pushbutton System Contract such that the Yard Route Pushbutton System will perform in accordance with the Specifications set forth herein. In addition, for the Yard Route Pushbutton System, the Contractor shall provide a warranty covering software defects and system stability starting when the Yard Route Pushbutton System hardware is placed into revenue service and continuing until 12 months after successful completion of the 30DOT.

b. The warranty period for spare parts shall extend either 12 months after the beginning of operation or until 2 years after acceptance, whichever occurs first. In the event it is necessary to place any spare parts into operation or service prior to the completion of the warranty period, the Contractor covenants and agrees to furnish and deliver free to the Administration a replacement part for the Administration's spare parts inventory.

c. For every identified system fault, the Administration will first endeavor to correct the fault with their own forces as trained by the Contractor. In the event that the Administration's maintenance forces are unable to correct the fault within four hours, the Administration may request the Contractor to provide assistance The Contractor shall have personnel available twenty-four (24) hours a day, seven (7) days a week to perform warranty services. If personnel are designated as "On-call", they shall be able to report for duty no longer than eight hours after callout. Performance of the Yard Route Pushbutton System in accordance with the documents herein, and the approved "as-built" documents shall be referred to as performing in "Working Order".

2. Warranty Service of the Yard Route Pushbutton System shall include:

a. On-site diagnosis and repair of defects in the equipment and software furnished herein; as well as technical support regarding the operational use of the Yard Route Pushbutton System. Contractor shall provide diagnosis and fault isolation participation in any and all intra or inter facility communications troubles affecting the Yard Route Pushbutton System, regardless of whether maintenance is provided by the Contractor or a third party. In the event the Yard Route Pushbutton System is not in Working Order, the Contractor shall dispatch service personnel to the Work Site as described herein.

b. Repair or replacement of all removed defective components, irrespective of whether the component was replaced by the Administration or by the Contractor.

c. In the event Yard Route Pushbutton System is not working in accordance with the Specification and the Administration needs on-site assistance, the Contractor shall dispatch service personnel to the Work Site to arrive within 8 hours of notification by the Administration.

d. In the event that the Yard Route Pushbutton System is not in Working Order, and the Contractor has exceeded either of the standards of System Availability because of a malfunction which, in the opinion of the Administration, is unlikely to be resolved by the Contractor, the Administration may, at the Contractor's expense, restore the Yard Route Pushbutton System to Working Order or provide a work around. Contractor shall credit to the Administration

the expenses associated with any third party work up to the amount of the Monthly Warranty Payment.

e. Contractor shall identify service personnel who will be assigned to perform maintenance and warranty service for the Administration during the Warranty Period. This information shall be provided prior to the start of the 30DOT.

f. Contractor shall provide error corrections, updates and new releases to any proprietary software, and correction releases to third party software after obtaining a) the written approval of the Administration and b) documentation updates to reflect these software changes within fifteen (15) days of completion of said software updates. Errors shall include flaws in operation as defined in the manuals supplied to the Administration and errors due to flaws in the design and coding of the software. Contractor shall also make new releases of third party software available to the Administration at the Administration's option and expense.

g. Contractor guarantees and warrants that work done and items procured shall (a) meet the requirements of this contract, (b) be free from defects in design, materials and workmanship, and (c) be free of all liens, encumbrances and other rights and interests of third parties. This guarantee and warranty shall apply to all discrepancies and defects that are discovered within twenty four months after the date of system acceptance. Remedial work to correct warranty defects shall be performed by the Contractor at a local repair facility, and shall include repair or replacement at the Contractor's option. Contractor shall not make any design modification to any component during the warranty period without the prior approval of the Administration.

h. In the event the Contractor fails to comply with its warranty obligations, Administration shall, upon written notice to the Contractor, have the right to deduct the downtime credits from any compensation due or which become due to the Contractor. In the event the Contractor has been paid, the Contractor agrees to compensate Administration for the costs thereof.

i. Spare parts shall be interchangeable with their corresponding part. All spare parts shall be reconfigured to the latest revision during the warranty period. Contractor shall have available at least two U.S. sources for spare parts. Contractor shall also endeavor to have other spare parts available from two U.S. sources. A detailed list of all spare parts with manufacturer name, model number, quantities required to be on hand and costs for one year after parts are out of warranty shall be provided.

j. Contractor is solely responsible for all costs of parts and/or labor incurred during the Warranty Period.

1.13 SUPPORT DURING INITIAL YARD OPERATIONS:

It is the Administration's intent to perform long-term maintenance with their own forces. During initial yard operations, Contractor shall provide technical assistance in troubleshooting, repair and maintenance as required. Contractor shall observe and support the Administration's maintenance personnel and advise them of necessary actions to provide a high level of quality maintenance. Contractor's total manpower requirement for this support during initial Route Pushbutton Control operations shall be 40 man-hours with a maximum of 10 occasions of 4 man-hours for each occasion. This support shall be on site support. Contractor provided support shall include but not be limited to one field engineer, one field technician, and one 1 foreman. Response time for these personnel shall be not more than 12 hours from the time contacted by the administration.

1.14 SOFTWARE UPGRADES

The Administration has defined in these contract documents the performance requirements for the PLC software. However, it is recognized that once the system is in operation, there may be some elements of system functionality that Light rail Operations or maintenance may prefer to function in some other manner. Software upgrades and/or revisions shall be provided at any time after successful completion of the FAT until 6 months after completion of Work Item 2 – Completion of all Contract Work (01110-1.17, Table-1.

A. The Software Upgrades payment item shall only be used for upgrades or changes directed by the MTA such as changing approved existing features or adding features. Any changes required because the system is found not to function as specified or as defined in the Contractor’s approved design documents shall be corrected at the Contractor’s expense.

B. When this payment item is to be used, MTA will define the details of the change or upgrade in writing and request an hour estimate to complete the work including installation, testing and updates to all applicable software documentation.

C. Changes may be to any application software furnished by the Contractor including, but not necessarily limited to the PLC application software, GUI display or GUI/PLC interface.

D. Software upgrades shall be implemented by personnel who are thoroughly familiar with the system as supplied by the Contractor and preferably by the same personnel who developed the application software.

E. Changes shall be implemented using the same development software furnished to MTA. If the Contractor would prefer to use the development software copy provided to MTA, then accommodations will be made to allow the Contractor’s personnel to work at the North Avenue shop facility.

1.15 SPARE PARTS, SPECIAL TOOLS AND EQUIPMENT:

As specified in Section 17690

1.16 LICENSES

All licenses associated with all software and hardware provided by the Contractor shall be irrevocable and shall not have any ongoing, time based charges to the MTA.

1.17 COMPLETION TIME, DURATION OF PERFORMANCE AND LIQUIDATED DAMAGES:

A. Pursuant to General Provisions, commence work on or before the date specified in the Notice to Proceed (NTP) and complete the specified portions of the work in Table 1 within the number of calendar days specified and without causing disruptions to train service.

B. The final contract completion date will be 90 calendar days after the date for project completion that appears in Table 1. The date for project completion that appears on the Contractor's approved project schedule to the 90th day after that date shall be referred to as the 90-Day Period. No charges or claims for damages shall be made by the Contractor for any delays or hindrances, from any cause whatsoever, during the progress of any portion of the work specified in this contract that occurs in the 90-Day Period. Furthermore, no liquidated damages may be assessed by MTA for Contractor delay that occurs during the 90-Day Period.

C. In the event that the Contractor fails to complete the work within the specified number of days plus the non-compensable time per the above paragraph 1.16 B after Notice to Proceed, liquidated damages will be assessed pursuant to General Provisions for each calendar day the completion of the specified work is delayed, or occurrence of disruption of service during the period of this Contract.

TABLE 1

WORK ITEM	NUMBER OF CALENDAR DAYS	LIQUIDATED DAMAGES PER CALENDAR DAY
1. Completion of FIAT	360 Days plus 90 Days	$1,370.00
2. Completion of <u>All</u> Contract Work except Software Upgrades	450 Days plus 90 Days	$1,370.00

D. The Contractor shall pay to the Administration the applicable amount specified and pursuant to General Provisions as liquidated damages for every additional calendar day in excess of the number of days prescribed or for violations of the contract as listed above. The Administration may deduct the sum of liquidated

damages from any monies due or that may become due the Contractor under the Contract, or if such monies are insufficient, the Contractor or sureties thereof shall pay to the Administration any deficiency within 30 calendar days.

E. Other contracts and contractors associated may be present in the project area during the construction period. The Contractor shall coordinate shared access at construction locations during track closures and at other times. Where this coordination results in restriction to the Contractor's work site access, the Contractor shall provide for workarounds to allow the continuance of construction. These workarounds shall not constitute a basis for a contractor delay or extension claim or for additional cost to the Administration in any way.

F. Other schedule requirements are given in Section 01300 Submittals

1.18 CONTRACTOR REPRESENTATIVES AND STAFF QUALIFICATIONS:

A. Designate in Writing within 5 days after receiving the Notice to Proceed (NTP), the name, official mailing address and telephone number of the Contractor's representative having complete Authority to represent and to act for the Contractor and the subcontractors.

B. Critical project work, such as system design, installation, transition and testing shall be performed by personnel who are qualified by their experience to perform such work, so that the system is delivered to the Administration in a fully functional and safe operating condition. Design work shall be overseen by professional engineers registered in the state of Maryland.

C. If, in the opinion of the Administration, any contractor's personnel are not satisfactory in the performance of services to be finished hereunder, the Contractor shall remove such personnel and replace them with personnel satisfactory to the Administration. Qualifications of any of the Contractor's personnel shall be presented to the Administration upon request.

1.19 LIABILITY INSURANCE REQUIREMENTS:

A. The Administration has chosen to provide Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective coverage on behalf of contractors and subcontractors working on this project. This approach to project insurance is commonly called a wrap-up or Owner Controlled Insurance Program (OCIP). Specific information regarding Liability Insurance Requirements is contained in the Contract Specification Book. (See Table of Contents for location of this information.)

B. Contractors and subcontractors are to bid work for this project net of insurance (i.e. The Cost of Workers' Compensation, General Liability, Excess Liability, Builders Risk, Pollution Liability and Railroad Protective applicable to the work site is not be to included in the bid price). All bidders must complete the Insurance Premium Worksheet (provide in the in the contract documents) and forward to the Administration with the rest of your price package. The Premium

Worksheet is included in the bid package herein. This form should include the Contractor's work as well as the work of all subcontractors included in the initial bid. The insurance premium shown on this form, or the pro rata portion thereof, will be added to the base bid in the event you are excluded from the wrap-up program or the program is terminated mid-term.

1.20 WORK RESTRICTIONS

A. Vendors shall adhere to the following requirements for scheduling access and work schedules should reflect the following general and location specific access restrictions:

1. Contractor access to facilities is coordinated two weeks in advance through the Administration's Metro Red tag and Work Block coordination meetings.

2. Weekly "Red Tag" meetings are held to coordinate contractor's work areas, schedule MTA escorts, plan track access, power outages or any other variances of normal service activities.

1.21 WORK SEQUENCE:

A. Contractor shall sequence all construction work in phases to accommodate the Administration's operating and occupancy requirements during the construction period and in accordance with the approved migration plan, staging plan; coordinate construction schedule (project schedule) with the Engineer.

1.22 CONTINGENT ITEMS:

A. Construction items for which quantities are listed in the Unit Price Schedule as "Contingent" are established for the purpose of obtaining bids on one or more pay items that may be incorporated into the project.

B. The Engineer will have sole discretion in determining whether and to what extent these items will be incorporated into the project. The Engineer may order these items to be used at any location within the project and anytime during the work. In most cases contingent items will not be shown on the Plans. The estimated quantities specified in the Unit Price Schedule for these items are presented solely for the purpose of obtaining a representative bid price. The total of actual quantities required for the construction may be only a fraction of, or many times the estimated quantity. The requirements of GP-4.04 (Variations in Estimated Quantities) shall apply.

1.23 ELIMINATED ITEMS:

A. Should any Contract items contained in the Unit Price Schedule be found unnecessary for the proper completion of the work contracted, the Engineer may, upon written order to the Contractor, eliminate such Contract items from the Contract.

B. No allowance will be made for items so eliminated in making final payment to the Contractor except for material costs incurred prior to notification of the eliminated of the items.

PART 2: PRODUCTS

2.01 OTHER OPERATIONAL REQUIREMENTS:

A. Failover Capability: If any interlocking is being controlled from the LRC at the time communications is lost between LRC and the interlocking, such loss of communications shall be detected and the interlocking automatically returned to the route pushbutton mode.

2.02 PRODUCT REQUIREMENTS:

A. Provide a proven and modern Non-Vital Route Request and Indication System within project limits as shown, in both system wide aspects and component design. Contractor shall demonstrate through the submittal of documents at least 5 years revenue experience in a transit environment.

B. All equipment and material shall be standard products of manufacturers regularly engaged in the production of signal and control equipment and material, and conform to the UL, NEMA, ANSI, AREMA standards, where applicable. All products provided in this Contract shall require approval of the Administration.

C. Assemblies and components that perform identical functions within the systems shall be mechanically and electrically interchangeable. Standardized, commercially available components of multiple sources shall be used whenever possible, particularly for items which require replacement at predictable intervals.

D. American Railway Engineering and Maintenance of Way Association (AREMA) Requirements: All electronic devices and components shall conform to requirements of Section 14 of the Signal recommendations of AREMA.

2.03 MAINTAINABILITY DESIGN REQUIREMENTS:

These requirements are in addition to the maintainability criteria as specified in Section 17021.

A. All test points, indications and components requiring adjustment or replacement shall be visible and accessible while mounted in their normal position, without disassembly of other components.

B. Test points for checking essential voltages and waver forms shall be clearly labeled and be provided whenever required for troubleshooting and routine maintenance, and be capable of accepting probes and connectors used with standards equipment such as voltmeters and oscilloscopes. Accessible points shall be provided where signals are injected for testing.

C. Built-in indicators or meters shall be provided as necessary when frequent observations or adjustments are necessary. All electronic modules shall be equipped with LED or other approved indicators. They shall as a minimum demonstrate that each function of the module is performing correctly. All indicators shall be labeled.

D. The contractor shall design furnish and install an event recorder for each CIH as described in specification section 17177.

2.04 SAFETY REQUIREMENTS

These requirements shall be used in addition to the safety requirements as specified in Section 17021. Within the framework of the overall performance goals of the system, all control methods, circuitry, mechanical equipment, and operating procedures provided by Contractor shall conform to these requirements. Whenever an unsafe condition could develop from an equipment failure, fail-safe design technique shall be used to prevent the occurrences of the unsafe condition.

A. The PLC programming while being non-vital, shall emulate the circuit check and design methods used for vital signal circuits. This shall include but not be limited to the following:

1. Route locking
2. Detector Locking
3. Time Locking
4. Switch Control and Indication
5. Other methods as described in section 17195

B. Equipment failures and conditions which shall be considered when producing this design:

1. Vital Relays
2. Non-Vital Relays: Open coil, high contact resistance, shorted turns.
3. Absent and abnormal input signals.
4. Opens and shorts inputs and at outputs.

C. The design shall minimize the possibility of unsafe failure arising from procedural error and neglect, including:

1. Careless adjustment of equipment and controls.
2. Incorrect assembly of equipment.
3. Insufficient maintenance.

2.05 IDENTIFICATION METHODS: All signal equipment modules, assemblies, subassemblies and wires shall be identified by means of tags or other means as specified in Section 17263.

2.06 ELECTROMAGNETIC COMPATIBILITY:

A. Ensure the Non-Vital Route Request and Indication System shall operate in its specified operational environments. Contractor shall ensure the Non-Vital Route Request and Indication System will not suffer from or cause harmful electromagnetic interference, either conducted, radiated, or induced.

B. Make provisions in the design for the radiated, conducted and induced emission from other electrical systems in addition to those supplied under this Contract.

PART 3: EXECUTION

3.01 INSTALLATION: Unless modified elsewhere in these Specifications, electrical installation shall be governed by the provisions of the NEC Standard of the National Board of Fire Underwriters for Electrical Wiring and Apparatus, and AREMA manuals. All provisions of these Codes shall be considered applicable whether or not specifically mentioned in these Specifications.

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL REQUIREMENTS:

A. With the exception of Support During Initial Yard Operations and Software Upgrades, no separate payment shall be made for the work required under this Section. All costs in connection therewith will be considered included in the bid items requiring their use.

B. Support During Initial Yard Operations will be measured by the hour and paid for at the contract unit price including all costs for travel and living.

C. Software Upgrades will be measured by the hour and paid for at the contract unit price including all costs for travel and living.

END OF SECTION

SECTION 01130

CONSTRUCTION PROCEDURES

PART 1: GENERAL

1.01 DESCRIPTION

A. This section specifies the requirements for preparing to perform the work. This Section includes:

1. Mobilization
2. Pre-construction Meeting
3. Construction Layout
4. Construction Safety Requirements
5. Protection of Utilities
6. Protection of Property
7. Fire Protection
8. Disposal of Material Outside the Work Site
9. Measurement of Quantities
10. Final Inspection

B. Related Sections:

1. Section 01300 – Submittals
2. Section 01450 – Quality Assurance and Quality Control

1.02 MOBILIZATION:

A. Mobilization includes the preparation of all construction equipment, materials, supplies, appurtenances and other items for commencing and prosecuting the Work; and the subsequent demobilization and removal from the site of the same construction equipment, appurtenances and other items upon completion of the Work.

B. Mobilization also includes assembly and delivery to the site of plant, equipment, materials and supplies necessary for the prosecution of the Work that are not intended to be incorporated into the Work; clearing of and preparation of the Contractor's work area; the complete assembly in working order of all equipment necessary to perform the required Work; personnel services and work preparatory to commencing actual work; and all other items for which payment is provided under this Contract.

C. Mobilization shall be considered as complete only after the submission of the Contractor’s Quality Control Plans (CQC Plans) in accordance with the Contract Specification Section 01450 and after the subsequent approval of these plans by the Engineer.

1.03 PRE-CONSTRUCTION MEETING:

A. Requirements for the pre-construction meeting are contained in Supplementary General Provisions.

B. After Award of the Contract, the Engineer will request the participation of the Contractor in a pre-construction meeting. The date, time and agenda of the meeting will be determined by the Engineer. Minutes of the meeting will be prepared by the Engineer.

1.04 CONSTRUCTION LAYOUT:

A. The Contractor shall use a Registered Land Surveyor licensed in the State of Maryland and state of he art equipment for all engineering work required to set and maintain all lines, elevations and dimensions as specified in the Contract Documents. Include as the Work progresses:

1. Verify that the field locations of the established base lines and bench marks correspond with figures shown on the Drawings. Include verification to the nearest established reference points beyond the limits of this Contract.

2. Establish bench marks and base lines showing exact elevations and other lines and dimensional reference points as required for the execution of the Work.

3. Field check the structure and surveys as required by the technical sections of the Specifications.

B. Verify all existing dimensions and grades shown on the Contract Drawings. Notify the Engineer in writing of any discrepancies found. Check the Drawings against established lines and grades and notify the

Engineer in writing of all discrepancies found before proceeding with the work.

C. Furnish a certificate signed by the Registered Land Surveyor warranting that all principal lines, levels and dimensions are accurately established in accordance with the Contract Drawings.

D. Submit all drawings and survey notes in accordance with Section 01300 SUBMITTALS.

E. The Contractor shall exercise care in the preservation of monuments, stakes, and bench marks set by the Engineer and shall reestablish them at no additional cost to the Administration when any are damaged or destroyed.

1.05 CONSTRUCTION SAFETY REQUIREMENTS

A. In accordance with and in addition to the General Provision's Articles GP-7.05 and GP-7.06 and Supplementary General Provisions:

1. The Contractor shall ensure observance of the most stringent provisions of the applicable statues and regulations of the State of Maryland or political subdivisions in which the Work is being performed, as well as the OSHA provisions pertaining to the safe performance of the Work.

2. The Contractor shall ensure that the methods of performing the Work do not involve undue danger to the personnel employed thereon, the public, and public and private property as specified in the General Provision Article PUBLIC CONVENIENCE AND SAFETY.

3. Should charges of violation of any of the above be issued to the Contractor in the course of the Work, submit a copy of each charge immediately to the Engineer.

1.06 PROTECTION OF UTILITIES

A. Utilities known to the Administration are shown on the Contract Drawings. The location of these utilities are not guaranteed, nor is there any guarantee that other utilities are not present. Unless otherwise specifically provided, the Contractor shall cause no interruption of service and protect utilities from damage.

B. Prior to performing excavation or grading at any location, contact the Utility Services Protection Center, “Miss Utility”, 1-800-257-7777. This

contact shall be made between the hours of 7:00 am and 5:00 p.m., Monday through Friday, excluding holidays and at least forty-eight (48) hours in advance of the proposed work. This will allow Utility companies time to properly mark the location of their facilities. In making the notification, the Contractor shall 1) state the nature of the work to be done; 2) give the location of the job, and 3) advise the utilities of the time and date that the Contractor's work will start. No work shall be commenced until the Utility companies affected have properly located their facilities to prevent damage thereto.

C. The Contractor shall exercise care when digging adjacent to and crossing any existing utilities. For overhead facilities, the Contractor shall adhere to the Maryland High Voltage Line Act.

D. The Contractor shall establish and maintain direct contact with the owner or operator of each utility which may be affected by the Work, and proceed with work which may affect a utility only with the cooperation and approval of the utility owner and the Engineer.

E. The Contractor before commencing work shall verify the location of all utilities in the vicinity of the Work and submit to the Engineer, for approval, a plan for performing the Work (CDRL).

1.07 PROTECTION OF PROPERTY

A. Requirements hereinafter specified are in addition to General Provision's Article GP-7.11.

B. Existing Facilities:

1. The Contractor shall take positive action to protect all existing facilities from any damage resulting from construction operations unless modifications to the facilities are required as part of the Contract. Where modifications to existing facilities are required, provide such modifications as shown on the Contract Drawings.

2. The Contractor shall protect all paving, landscaping, and utilities from damage.

3. The Contractor shall protect all finished surfaces, against any possible damage.

4. The Contractor shall provide and maintain adequate protection for all adjacent structures. When required by law, or for the safety of the Work, shore, brace, underpin or otherwise protect those portions of adjacent structures which maybe affected by the work.

Prior to commencement of any part of the Work, give any notice required to be given to adjoining landowners or other parties.

5. Items removed for the convenience of the Contractor or to expedite his operations shall be restored, repaired, reinstalled or replaced with new work and refinished, as appropriate, to a condition equal to or better than existed prior to the commencing of the Work. Materials and workmanship used in repair or restoration work shall conform in type and quality to original existing construction.

6. The Contractor shall inspect existing items to be altered, extended, salvaged or relocated and reused. If an existing item is found to be defective in any way, the Contractor shall report the condition to the Engineer before the item is disturbed.

C. New Work:

1. The Contractor shall ensure finished surfaces of items are clean and not marred upon acceptance of the Work. Refinish all surfaces that have been damaged.

2. The Contractor shall provide and maintain protection at all times against weather so as to preserve all work, materials and fixtures free from injury or damage.

3. The Contractor shall not load or permit any part of a structure to be so loaded as to either create an unsafe condition or affect its structural integrity.

4. The Contractor shall not use items of equipment that are intended to form a part of the completed work as construction equipment without specific approval from the Engineer in each instance.

D. Repair of Damage:

1. The Contractor shall repair all damage to surfaces or facilities, which are to remain in place, as directed by the Engineer.

2. The Contractor shall ensure that repairs result in conditions equal in strength to the previous conditions.

3. The Contractor shall ensure repaired surfaces are identical in color and texture to the adjacent existing materials, except where materials can not be matched. When the area cannot be matched, the Contractor shall refinish the affected area and surrounding area

to give a uniform appearance acceptable to the Engineer and the owner of the damaged facility.

1.08 FIRE PROTECTION

A. The Contractor shall provide temporary fire protection for use during the term of the Contract, subject to approval of the Engineer.

B. The Contractor shall comply with provisions for fire protection systems and equipment as required by OSHA, Safety and Health Regulations for construction, Part 1926, Subpart F - Fire Protection and Prevention.

1.09 DISPOSAL OF MATERIAL OUTSIDE THE WORK SITE

A. Unless otherwise specified elsewhere in the Specifications, the Contractor shall make arrangements for disposing of waste outside the work site and pay all associated costs.

B. Prior to disposing of material outside the work site, obtain written permission from the owner on whose property the disposal is to be made. File with the Engineer the permit, or a certified copy thereof, together with a written release from the property owner absolving the Administration from any and all responsibility in connection with the disposal of material on said property.

1.10 MEASUREMENT OF QUANTITIES

A. All work to be paid for at the Contact price per unit of measurement will be measured by the Engineer in accordance with U.S. Standard Measures. A ton shall consist of 2,000 pounds avoirdupois.

B. Material paid for by weight shall be weighed on accurate, approved scales, furnished by and at the expense of the Contractor. Use platform scales of sufficient size and capacity to permit the entire vehicle or combination of vehicles to rest on the scale platform while being weighed. Combinations of vehicles may be weighed as separate units provided that they are disconnected while being weighed. Have all scales inspected and certified as often as the Engineer may deem necessary to ascertain accuracy. Cost incurred as a result of regulating, testing, inspecting, and certifying scales shall be borne by the Contractor.

C. The Engineer may be present to witness the weighing and to check and compile the daily record of such scale weights; however, in any case, the Engineer will require the Contractor furnish weigh slips and daily summary weigh sheets. In such cases, furnish a duplicate weigh slip or a

load slip in each vehicle weighed and deliver the slip to the Engineer at the point of material delivery.

D. Trucks used to haul material being paid by weigh shall be weighed empty on a daily basis and as such times as the Engineer may require. Each truck shall bear a plainly legible identification mark. The Engineer may require the weight of the material to be verified by weighing empty and loaded trucks on such other scales as the Engineer may designate.

E. When material is to be measured and paid for on a volume basis it shall be accomplished using the average end method and when impractical to determine the volume by specific method of measurement, or then requested by the Contractor in writing and approved by the Engineer in writing, the material will be weighed in accordance with the requirements specified for weight measurement. Such weights will be converted to volume for payment purposes. Factor for conversion from weight agreed to by the Contractor before such method of measurement of pay quantities will be adopted.

F. When metering devices are required in the Specifications or are used to measure the quantity of liquids used in the work, the metering devices shall be inspected and tested for accuracy at the Contractor's expense as often as the Engineer may deem necessary.

G. Full compensation for all expenses involved in conforming to the requirements for measuring and weighing materials shall be considered as included in the unit prices for the materials being measured or weighed and no additional compensation will be allowed therefor.

H. Quantities of material wasted or disposed of in a manner not called for under the Contract; rejected loads of materials, including material rejected after it has been placed by reasons of failure of the Contractor to conform to the provision of the Contract's material not unloaded from the transporting vehicle; material placed outside the lines indicated on the Contract Drawings or established by the Engineer; or material remaining on hand after completion of the work will not be paid for, and such quantities will not be included in the final total quantities. No compensation will be allowed for loading, hauling and disposing of unused rejected material.

1.11 FINAL INSPECTION

A. Notify the Engineer at least 10 calendar day in advance of the date the work at each bid item will be fully complete and ready for final inspection.

PART 2: PRODUCTS
NOT USED

PART 3: EXECUTION
NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 MOBILIZATION

A. The work required under this Section will not be measured for payment.

B. Fifty percent of the Fixed Price shown in the Unit Price Schedule for the item MOBILIZATION will be payable on the first monthly invoice subsequent to the Contractor's moving in all necessary facilities and performing all work, as described above, that will enable work to begin satisfactorily on the preliminary contract items. Further, twenty-five percent of the first monthly invoice amount due to the Contractor for the item MOBILIZATION shall be withheld and released only after the Engineer’s approval of the CQC plans. The remaining fifty percent will be payable in equal installments on each of the subsequent monthly invoices, for a maximum of five months, provided that, in the opinion of the Engineer, mobilization continues to proceed satisfactorily. Payment as specified above shall be full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing the work necessary to complete the work described in this Section. Payment for the Fixed Price shown in the Unit Price Schedule for the item MOBILIZATION will not be made more than once, regardless of the fact that the Contractor may, for any reason, shut down work on the project or move equipment away from the project and then back again.

4.02 PRE-CONSTRUCTION MEETING:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.03 CONSTRUCTION LAYOUT:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.04 CONSTRUCTION SAFETY REQUIREMENTS

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.05 PROTECTION OF UTILITIES

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.06 PROTECTION OF PROPERTY

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.07 FIRE PROTECTION

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.08 DISPOSAL OF MATERIAL OUTSIDE THE WORK SITE

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.09 MEASUREMENT OF QUANTITIES

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.10 FINAL INSPECTION

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 01150

INTERFACE REQUIREMENTS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section describes the Contractor's obligations and other pertinent information relative to the various interfaces between the Contractor and the Administration and other third parties.

B. Contractor's requirement for design and development of the interface between Contractor-furnished equipment and existing Light Rail equipment is covered in the contract documents.

C. Related Work Specified Elsewhere:

1. Section 01110: Summary of Work
2. Section 01130: Construction Procedures
3. Section 01300: Submittals
4. Section 01310: Coordination and Meetings
5. Section 01500: Temporary Facilities and Controls

1.02 INTERFACES:

A. The Contractor shall be responsible for the design, development and implementation of the interface procedures between its work and work performed by others, and for Contractor work at all interface locations with existing Administration and other third party facilities.

B. The Contractor is reminded that the work under this Contract is to be performed in the existing Light Rail North Avenue Yard. All work interfacing with the existing Light Rail shall be scheduled with the approval of the Administration to avoid disruption of rail service schedules and traffic.

C. Administration Interface:

1. The Contractor will be permitted access to operating portions of the system on a prearranged basis. Access requests must be submitted in writing, with at least seven (7) days notice, to the Administration. See Section 01300.

a. Escorts and Access will be provided by the Administration. These will include scheduling, work staging, construction interfacing, and the environment under which the work will be accomplished.

b. The Contractor shall attend weekly meetings (in addition to the Project Meetings as provided for in the contract documents) with the Administration and shall provide a two week look ahead describe his work plan. These meetings will be used to provide coordination and to resolve issues among the project team and the Administration.

2. Any installation or testing which affects existing Light Rail train operations must be done during the hours to be approved through the WORK BLOCK and RED TAG meetings by the Administration and must be completed in sufficient time to allow for normal Light Rail service. It is the Contractor's responsibility to supply sufficient competent employees and reserves to assure restoration of scheduled service within the allotted time. The Contractor must furnish all equipment such as, but not limited to flags, safety vests, flares, phones and radios. The providing of such flagmen, watchmen, and other precautionary measures, shall not, however relieve the Contractor from liability for payment of damages caused by its operations. The training of any and all personal who will perform track work and work surrounding track area shall be provided by the Administration and paid for by the contractor. The contractor assumes all liability for this work and the diligences of these persons to perform their operations as trained.

3. The Contractor will not be permitted to use Administration personnel for purposes of its own even though such personnel may be required at the immediate site of project construction by the Administration solely for the safe operations of trains or protection of facilities.

4. During the passing of trains all equipment within the fouling area shall cease operation and idle in a static position until the flagman allows resumption.

5. Any work crew interfacing with the existing Light Rail operations must be supervised by a Contractors employee(s) who has attended and been certified at the MTA Track Access Course. The Contractor shall coordinate with the Administration for times, dates and locations to attend this class.

6. Work which does not affect train operations may be performed, with the authorization of the Administration, during Light Rail

operation hours. General Orders/Bulletins, as required, will be issued by the Administration. See Work Restrictions provided in Section 01110. The Contractor will furnish flagmen, watchmen, or other employees as may be deemed necessary for safe and continuous operations at no additional cost. Detailed plans of the Contractor's procedures, including itemized time schedule and breakdown of the labor force shall be submitted to the Administration at least ten (10) days prior to implementation. The Administration reserves the right to determine the number of flagmen necessary based on the Contractor's work plan.

7. Cooperate with the Administration and respond within a period of fifteen (15) days following receipt of any request for information on behalf of the Administration. The Administration will be required to respond in a similar manner to requests from the Contractor.

8. Materials and equipment belonging to the Contractor shall not be stored on Administration property without first having obtained permission from the Administration and such permission will be on the condition that the Administration will not be liable for damage to such materials and equipment from any cause. The storage of materials or equipment shall not block access roads. The Contractor shall keep the tracks adjacent to the site clear of all refuse and debris that may accumulate from its operations, and shall leave the Administration property in the condition existing before the start of its operation. The Contractor shall also be liable for any damages to Administration property or facilities caused by the storage, failure, vandalism, etc., of stored material or equipment.

9. Upon completion of the Work, and before final payment is made, the Contractor shall remove from within the limits of the Administration right-of-way all machinery, equipment, surplus materials, false work, rubbish, and temporary buildings and other property of the Contractor, and shall leave the right-of-way in a condition satisfactory to Administration.

D. Operating Rail Line Interface:

1. The Contractor shall submit an installation and cutover sequence plan (migration and interface plan) for all areas of construction which affect existing Light Rail operations (CDRL). The plan shall be submitted, to the Administration, seven (7) days prior to commencing any field installation work, and shall include, at a minimum, the following:

a. Narrative descriptions and schematics for temporary or interim circuits and materials.

b. Installation methods and sequencing implementation.

c. Narrative descriptions and schematics to maintain existing operations and rail traffic.

2. Coordinate all interface work with the Administration.

3. The Contractor shall be responsible for the protection of existing equipment and facilities while working on the system.

4. Where the Contractor's submitted sequencing schedule necessitates a Systems interface (construction, modification, testing, and/or shutdown and startup of the signal, communication, and/or traction power systems), the Engineer shall provide information on specific activities and durations necessary for this interface. These shall be provided for by the Contractor in a revised sequencing plan submittal (CDRL). The Contractor shall be responsible for providing work around plans to allow continued productivity during the Systems activities. No claim for delay or additional compensation to the Contractor will be made for the provision of Systems interface.

5. The Contractor is alerted that trains may run in either direction on any track at any time.

E. Hi-Rail Vehicle Interface:

1. All Contractor-furnished equipment shall be fully compatible with the Metro hi-rail vehicles and equipment.

F. Light Rail Line Interfaces:

1. Trains may operate on any yard track in either direction at any time and on any day of the week.

2. The Contractor must not disrupt, inhibit or anyway interfere with Light Rail train movements. Work that may limit the ability of MTA to operate trains in certain areas of the yard shall be coordinated through the Work Block and red tag meetings prior to the start of any such work.

G. Maintenance Interface:

1. The Administration frequently performs Light Rail Vehicle testing, track, and signal maintenance during non-revenue hours. The Administration may use track vehicles to accomplish the work such as a high rail vehicle and tamper. The Contractor shall plan and

coordinate all work with the Administration to allow maintenance work to be performed without disruption.

H. Electrical Interface:

1. Prior to ordering electrical equipment and materials the Contractor shall familiarize himself with each site and field verify and document the existing electrical characteristics (i.e. voltage, phase, amperage) for each site and report any discrepancies to the Administration before proceeding with any work.

2. Interface shall include but not be limited to the following:

a. Modifications to existing electrical systems.

b. Grounding

c. Manual Transfer Systems

d. UPS systems

e. Feeders

f. Existing underground electrical work.

I. Utilities and other Third Party Interfaces:

1. The Contractor shall be responsible for coordinating all utility and other third party interfaces and notifications directly with the appropriate utility company or third party. A copy of all written correspondence and a transcription of all verbal communication between the Contractor and the utility or third party shall be forwarded to the Engineer.

2. For all work under this Contract, any lighting and electric power, where not specifically provided by others, including on a temporary basis, when permanent facilities are out of service or not available, shall be provided by the Contractor at no cost to the Administration.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 GENERAL:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Section 01110.

END OF SECTION

SECTION 01210

MISCELLANEOUS WORK ALLOWANCE

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work covered under this section includes the furnishing of all materials, equipment and the performing of all labor to complete additional work directed by the Engineer.

B. This work shall include, but is not limited to: additional work not included in the scope of any other item in the Proposed Form. This shall include hidden or unforeseen site conditions and approved extra work required by the Engineer after award of the contract, which was not included in the advertised contract documents and within the general scope of the contract.

C. This allowance is for the exclusive use of the Maryland Transit Administration and is to be distributed at its sole discretion. All unused monies remaining in the allowance at contract closeout shall be deleted from the contract.

D. This allowance is for the cost associated with changes related to direct cost only. Changes/Change Orders including time related delay costs such as indirect field, home office overhead, etc. shall not be issued and/or paid under this section.

E. The work covered under this section shall not include any time extension to the contract or to any intermediate milestones.

F. Any work to be performed under this section shall be approved in writing and shall be authorized at the discretion of the Engineer.

PART 2: PRODUCTS

2.01 PRODUCTS AND MATERIALS:

A. Any material to be used under this Section shall be approved by the Engineer before purchase.

PART 3: EXECUTION

3.01 EXECUTION:

A. The Contractor's methods and techniques which he proposes to utilize in performing the work shall be subject to the review of the Engineer.

B. When this allowance is utilized for work with items specified elsewhere in these specifications, the work shall be performed in accordance with materials and methods of construction of those items.

C. When the Contractor is entitled to a cost entitlement as a result of additions or changes to the contract for which there are no applicable unit prices, the Engineer shall request a price proposal from the Contractor prior to the start of work in accordance with Contract Provision GP 4.06 – "CHANGES."

D. The Contractor shall not begin work under this section unless directed by the Engineer in writing. If necessary, plans and details may be generated and provided to the Contractor for each specific condition and area.

3.02 WORK AT CONSTRUCTION SITE:

A. The direct cost adjustment requirements of Supplementary General Provision Article SGP – 4.03 Negotiated Payment Provisions except paragraphs G & J shall apply only to work performed at the construction site and only when a contract direct cost adjustment is negotiated.

3.03 PROFESSIONAL AND TECHNICAL SERVICES:

A. The requirement of Supplementary General Provisions Article SGP – 4.06 Change Notices shall apply when a contractor is entitled to an equitable cost adjustment for additional work or changes requiring the services of factory or office based professional and/or technical personnel to perform the work directly attributable to additional work or changes.

3.04 FORCE ACCOUNT WORK:

A. Pursuant to the Contractor's proposal, if the Contractor and the Administration cannot reach an agreement, the Administration may require the Contractor to do such work on force account basis. The Contractor's cost entitlement shall be determined for such force account work in accordance with Supplementary General Provisions Article SGP – 9.02 Force Account Work.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. When the installed and accepted work is performed and agreed upon in writing pursuant to the direct cost adjustment requirements of Article SGP – 4.03 with the exception of paragraph G & J, such work shall be paid from the allowance under "Miscellaneous Work Allowance."

B. When the installed and accepted work is performed and agreed upon in writing pursuant to the requirements of Article SGP – 4.06, such work shall be paid from the allowance under "Miscellaneous Work Allowance."

C. When the installed and accepted work is performed and agreed upon in writing pursuant to the requirements of Article SGP – 9.02, such work shall be paid from the allowance under "Miscellaneous Work Allowance."

D. The payment for additional work/changes under "Miscellaneous Work Allowance" includes any and all costs associated with this additional work.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies the general requirements and procedures for preparing and transmitting data to the Engineer for informational purposes or for approval. Other requirements for submittals may be specified under applicable sections of these Specifications. This Section includes:

1. Progress Schedule
2. Proposed Products List
3. Contractor's Drawings
4. Product Data
5. Sources of Supply and Samples
6. Manufacturers' Instructions
7. Manufacturers' Certificates
8. Operations and Maintenance Data
9. Progress Photographs
10. Request for Progress Payment
11. Estimated Cost Breakdown

B. Related Work Specified Elsewhere:

1. SECTION 01450 - Quality Control
2. SECTION 01780 - Contract Closeout

C. Unless specified otherwise elsewhere, submit three copies of all submittals, design documentation, drawings, plans, procedures and test results to the Administration for review and approval.

1.01 ELECTRONIC FILES

A. Whenever a submittal of any type or purpose is delivered to the Administration, an electronic copy of the submittal shall be simultaneousely posted on the Administration's ProjectWise file storage system. The Contractor will be provided with access privilages to the project file which will be accessible via the internet.

1. All files shall be posted in both their native file format and in .pdf format.
2. Drawing files shall be posted in a form that allows them to be directly readable.
3. File names shall include the submittal number, description and submittal date.

1.02 PROGRESS SCHEDULE (in lieu of GP-8.04.A):

A. General:

1. Full compliance with the following schedule submission requirement is essential to insure the timely processing of progress of progress payments.

2. The Contractor shall prepare and maintain a detailed progress schedule. This schedule shall be the Contractor's working schedule and shall be used to plan, organize and execute the work; record and report actual performance and progress; and forecast remaining work.

3. The Project Schedule shall employ CPM using retained logic for the planning, scheduling and reporting of the work to be performed under the Contract. The schedule will be produced utilizing the Primavera Project Planner (P3) software system. The type of schedule shall be Precedence Diagramming Method (PDM). The software shall be suitable for use on IBM compatible computers using the Microsoft Windows operating system.

4. Schedule work such that any specified intermediate milestone(s) and completion dates are met as specified in these Special Provisions.

5. The initial baseline schedule submittal shall reflect zero status, addressing the Contract work as viewed from Notice to Proceed looking forward in time.

B. Contractor's Scheduling Representative:

1. The Contractor shall designate in writing, and submit qualifications of, a Scheduling Representative, who shall be responsible for preparation and maintenance of the Project Schedule (CDRL). The Scheduling Representative may be from within the Contractor’s organization or an outside consultant. The Engineer shall have the right to disapprove the designated Scheduling Representative, in which case the Contractor must resubmit a replacement for approval. After acceptance, the Contractor may not replace the Scheduling Representative without prior written consent of the Engineer.

2. The Scheduling Representative shall have complete authority to act on behalf of the Contractor in fulfilling the Project Schedule requirements of the Contract and such authority shall not be interrupted throughout the duration of the Contract unless approved in writing by the Engineer.

3. The Scheduling Representative shall attend all schedule-related meetings and all monthly update meetings throughout the duration of the Contract in addition to the General Superintendent.

4. The Contractor agrees that whenever the Engineer advises the Contractor in writing that the Scheduling Representative is not performing his/her duties to the satisfaction of the Administration, the Contractor shall replace the Scheduling Representative at no additional cost to the Administration and designate in writing, within seven (7) calendar days, a new authorized representative satisfactory to the Engineer.

C. Progress Schedule:

1. Submit to the Engineer within twenty-one (21) days after Notice to Proceed for approval the Schedule and a Narrative explaining the schedule assumptions, restrictions and information as listed in item 2 below (CDRL).

2. Provide sufficient detail and clarity of form and technique so that the Contractor can properly control the Contract work and the Engineer can readily monitor and follow progress of the Contract work. The schedule shall reflect on time completion of all contractually specified intermediate milestones and completion dates. The degree of detail shall be to the satisfaction of the Engineer. As a minimum the following factors shall have a bearing on the required depth of detail:

a. The types of work to be performed.

b. Procurement, fabrication, delivery, installation and test activities for major systems and equipment.

c. Submittal and approval of shop drawing and material samples.

d. Access and availability to work areas.

e. Delivery of any Administration furnished equipment.

f. Interfaces and dependencies with preceding, concurrent and follow-on contractors.

g. Plans for subcontract work.

h. Manpower, material and equipment requirements and any restrictions thereto.

i. Planned normal workweek and planned restrictions.

j. Clearly depict the order and interdependencies of planned activities, including activities of others which affect planning.

k. Show the intended time for starting and completing each activity.

l. Show the intended duration for each activity.

m. Clearly and prominently identify specified intermediate milestones and completion dates.

n. All bar chart schedules shall have horizontal and vertical grid lines.

o. Anticipated lost time due to weather shall be included in the Schedule to ensure completion of all work within the Contract time. The Contractor's progress schedule must reflect these anticipated adverse weather delays in all weather dependant activities.

Monthly Anticipated Adverse Weather Delays
Work Days Based on 5 Day Work Week

Jan	Feb	Mar	Apr	May	Jun
8	8	7	4	1	1

Jul	Aug	Sep	Oct	Nov	Dec
2	2	2	2	4	5

These days will be eliminated from the Schedule's work calendar and spread over each month. Individual activity durations are not to be increased to include expected lost weather days.

Any temperature sensitive activities, such as asphalt paving, shall be indicated in the schedule and accepted by the Engineer as reasonable. The work calendar associated with these activities shall also be accepted by the Engineer.

3. Required Submittals (CDRLs):

a. Five (5) hard copies and one electronic copy, in the scheduling software of the Progress Schedule, reflecting contract milestone(s) and completion dates. If the submitted Progress Schedule is larger than 11 x 17 inches in size, a reproducible copy of the schedule shall be included in the submittal.

b. Five (5) copies of a narrative containing supplementary information describing the construction methods and any resources as well as restraints to enable the Engineer to evaluate the schedule for its usefulness as a valid and workable project control tool. Include an explanation of any schedule restraints that were incorporated. The narrative should contain information requested in the monthly update narrative as appropriate.

D. Administration's Review and Approval:

1. After submission of the complete schedule submittal, the Contractor shall participate in a conference with the Engineer to appraise and evaluate the proposed schedule and make any revisions necessary as a result of this review. The complete revised schedule shall be resubmitted within 10 calendar days after the conference.

2. When the Progress Schedule and Narrative documentation satisfy the Specification requirements and completion dates the Engineer will approve the Contractor's submittal.

E. Monthly Progress Schedule Updates (CDRLs):

1. At the request of the Engineer, participate in a pre-update conference to verify progress prior to the formal monthly submittal.

2. By the seventh of each month submit to the Engineer, for approval, five (5) copies and one electronic copy, in the scheduling software, each of:

a. Updated Progress Schedule. If the submitted update of the Progress Schedule is larger than 11 x 17 inches in size, a reproducible copy of the schedule shall be included in the submittal.

b. Narrative, covering as a minimum:

i. A description of physical progress during the report period.

ii. Problem areas, current and anticipated.

iii. Delays incurred during the report period and an explanation of the same.

iv. Delaying factors, their impact and an explanation of corrective actions taken or proposed to mitigate those delays.

v. Changes in activity duration including an explanation.

vi. Listing with explanation of added activities.

vii. Listing with explanation of deleted activities.

viii. Listing with explanation of changes in interdependencies.

ix. Plans for forthcoming report period.

3. Submit, for approval, a revised Progress Schedule and Narrative documentation data when one or more of the following conditions occur:

a. When a change or delay significantly affects any specified intermediate milestone date, the completion date or the sequence of activities.

b. When the Contractor elects to change a sequence of activities affecting any critical path or to significantly change the previously approved schedule submitted.

c. When, in the opinion of the Engineer, the status of work is such that the Progress Schedule and Narrative documentation are no longer representative for planning, executing and evaluating the work.

4. The monthly payment estimate may not be processed prior to the engineer's approval of the monthly Progress Schedule update at the discretion of the Administration.

F. Change Orders, Delays and Time Extensions: Articles GP-4.06, GP-5.14 and GP-8.08 of the General Provisions are augmented by the following requirements.

1. When proposed changes are initiated or delays are experienced submit to the Engineer in writing (CDRL):

   a. A Time Impact Analysis illustrating the influence of each change or delay on any specified intermediate milestone date or completion date. The Time Impact Analysis is to include, as a minimum, what critical path activities are affected on what specific workdays and why for each activity for each workday. Also, if the claim is for more than one contract milestone, the time impact Analysis is to address each contract milestone individually.

   b. A proposal demonstrating how the Contractor plans to incorporate the change or delay into the current Progress Schedule with minimal impact to milestone completion dates. Justification of the plan shall be based on revised activity logic and/or durations in addition to such other supporting evidence, as the Engineer deems necessary.

   c. Submit five (5) copies and one electronic copy, in the scheduling software of each Time Impact Analysis and schedule Revision Proposal within 30 days after the delay occurs or notice of direction is given to the Contractor.

2. The Engineer will, within a reasonable time after receipt of the Contractor's Time Impact Analysis and Schedule Revision Proposal, review the submittal and advise the contractor in writing thereof. Upon agreement by both parties the appropriate revisions shall be incorporated into the Progress Schedule at the next monthly update.

3. It is understood and agreed that the schedule float time is not for the exclusive use of either the Administration or the Contractor. Extensions of time for performance under any and all of the provisions of this Contract will be granted only to the extent the equitable time adjustment for activities affected exceed the total float along the paths involved.

G. Where the Engineer has not yet made a final determination, or the parties are unable to agree on the schedule revisions or time extensions, if any, the Contractor shall incorporate such revisions as the Engineer may determine to be appropriate for such interim purposes. It is understood and agreed that any such interim determination for the purpose of this

paragraph shall not be binding on either party for any other purpose and that, after the Engineer has made a final determination the Contractor shall revise the Progress Schedule in accordance with the final decision.

1.03 PROPOSED PRODUCTS LIST:

A. Within ten (10) days after date of Notice to Proceed, submit seven (7) copies of a complete list of major products proposed for use, with name of manufacturer, trade name, and model number for each product (CDRL). The Engineer's approval of the products list shall not relieve the Contractor of the contract requirements or the requirement of the Contractor to submit additional detail for fabricated products or more detailed elements of the project.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.04 CONTRACTOR'S DRAWINGS:

A. General:

1. The Contract Drawings show the general arrangement and such details as are necessary to provide a comprehensive description of the work to be performed.

2. The Contractor shall design all work per the scope of services and prepare Design Documents, Shop and Working Drawings as are necessary to adequately design and perform the work.

a. Contract Design Drawings and Shop and Working Drawings created specifically for this contract shall be prepared in accordance with MTA Drawing and CADD Standards in effect during the contract period. All such drawings shall be prepared using the current version of Bentley Microstation.

b. Contract Design Drawings and Shop and Working Drawings not created specifically for this contract shall be submitted in Bentley Microstation format or in .pdf format if not available in any other electronic form.

3. All Shop and Working Drawings shall be fully legible on sheets measuring 11 inches by 17 inches. All drawings in a set shall be the same size. Each drawing shall have a blank area 2-1/2 inches

by 2-1/2 inches on an 11 inch by 17 inch plot adjacent to the title block to provide space for Contractor and Engineer review stamps. The title block shall display the following:

a. Contract Number and Name

b. Number and Title of the Drawing

c. Date of Drawing or revision

d. Name of Contractor and Subcontractor submitting drawing

e. Clear identification of contents and location of work

4. Drawings and design calculations for support of excavation, sheeting and shoring, decking, falsework, form work, and for other temporary work and methods of construction the Contractor proposes to use, will be required to be furnished by the Contractor. Such drawings shall be left to the Contractor who shall be responsible for the safety and successful construction of the work. Drawings and design calculations which are the responsibility of the Contractor, shall bear the seal of a structural engineer, registered in the State of Maryland.

5. A Contractor's transmittal letter shall accompany each submittal. The Contractor's transmittal letter and submittal shall be consecutively numbered and shall clearly and completely describe any variation from the contract requirements.

6. A sequential number shall be shown on each Shop or Working Drawing submission. Re-submittals will be followed by a revision letter (A, B, C, etc.) and handled in the same manner as first submitted.

7. Submittals not conforming to the requirements of this specification shall be summarily rejected.

8. Review and Acceptance shall not relieve the Contractor from his responsibility for accuracy of submittals, for conformity of submittals to requirements of Contract Drawings and Specifications, for compatibility of the described product with contiguous products and the rest of the system, or for protection of completion of the Contract in accordance with the Contract Drawings and Specifications.

9. The Engineer's review, correction and acceptance of submittals shall not relieve the Contractor of responsibility for errors and omissions in submittals and associated calculations.

10. The Contractor's liability to the Administration, in case of deviations in the submittals from requirements of the Contract Document, is not relieved by the Engineer's review and acceptance of submittals containing deviations unless the Administration expressly approves the deviation through the issuance of a change notice.

11. Catalog cuts shall highlight the actual equipment/component proposed to be used. Generic catalog cuts will not be accepted.

12. If the material/equipment/components proposed to be used do not conform to the stipulated standards, the Contractor shall submit the copies of the conforming standards highlighting the deviations from the stipulated standards. The impact of the derivations on cost and performance shall be brought out in the related submittal and the deviation request.

13. Schedule submittals to expedite the Project, and deliver to Engineer. Coordinate submission of related items.

14. All submittals from Subcontractors shall be reviewed and approved by the Contractor prior to submittal to the Engineer. The Contractor's review and approval shall certify that the submitted project has been reviewed by the Contractor and that based on this review, it conforms the contract requirements. Further, the Contractor's approval shall certify that the intended product is compatible with all other products, to which it must integrate and to the overall project.

B. Shop and Working Drawings:

1. Submit three (3) legible copies plus the number of copies required by the Contractor of all Shop and Working Drawings and required specifications to the Engineer for approval (CDRL). These drawings shall be complete and detailed. Shop and Working Drawings shall consist of fabrication, erection and setting drawings, schedule drawings, manufacturer's scale drawings, wiring and control drawings, cuts from entire catalogs, pamphlets, descriptive literature, and performance and test data. Working Drawings shall be accompanied by calculations or other sufficient information to completely explain the structure, machine or system described and its intended manner of use.

2. Check and coordinate drawings and schedules with the work of all trades involved before they are submitted for the approval of the Engineer. Each drawing shall bear the Contractor's stamp of approval as evidence of such checking and coordination. Drawing schedules submitted with out this stamp of approval may be returned to the Contractor for resubmittal.

3. Submit all drawings and schedules sufficiently in advance of construction requirements to permit no less than twenty-one (21) days for review and appropriate action by the Engineer.

4. The approval of drawings and schedules will be general, but approval shall not be construed:

   a. As permitting any departure from the Contract requirements.

   b. As relieving the Contractor of the responsibility for any errors, including details, dimensions, and materials.

   c. As approving departures from details furnished by the Engineer, except as otherwise provided herein.

   d. As a Notice to Proceed on a change to the contract that would result in additional time or cost to the Contractor.

5. Drawings for work on utility facilities, streets, and other facilities which are constructed for owners other than the Administration shall be coordinated so that the information required by these owners is included on the Working Drawings for their facilities.

6. If drawings show variations from the Contract requirements because of standard shop practice or for other reasons, describe such variations in the letter of transmittal. If applicable, the Engineer may approve any or all such variations, subject to a proper adjustment in the Contract. If the Contractor fails to describe such variations he shall not be relieved of the responsibility for executing the work in accordance with the Contract, even though such drawings have been approved.

7. If the drawings or schedules as submitted describe variations in accordance with Article 1.04.B.6 herein and show a departure from the Contract requirements, which the Engineer finds to be in the interest of the Administration and to be so minor as not to involve a change in the Contract price or time performance, the Engineer may approve the drawings.

8. If accepted, or accepted as noted, by the Engineer, each copy of the drawing will be identified as having received such acceptance by being so stamped "Reviewed, No Exceptions Noted" or "Reviewed, Exceptions Noted" and dated. Drawings will also be identified as “Resubmittal Required” or “Resubmittal Not Required”.

9. Drawings stamped "Not Approved" and with the required corrections shown will be returned to the Contractor for correction and resubmittal. Resubmittals will be handled in the same manner as first submittals. On resubmittals the Contractor shall direct the specific attention, in writing or on resubmitted drawings, to revisions other than the corrections requested by the Engineer on previous submittals.

10. The Contractor shall make any corrections required by the Engineer. If the Contractor considers any correction indicated on the drawing to constitute a change of the Contract requirements, notice as required under the Section of the General Provisions entitled Changes shall be given to the Engineer.

11. The number of Shop and Working Drawings provided by the Contractor in excess of the number requested in Article 1.04.B.1 will be returned to the Contractor.

12. When Shop and Working Drawings have been completed to the satisfaction of the Engineer, the Contractor shall carry out the construction in accordance therewith and shall make no further changes except upon written instructions from the Engineer.

13. The Contractor shall be responsible for, and bear all cost of damages which may result from the ordering of any material or from proceeding with any part of the work prior to the approval by the Engineer of the necessary Shop and Working drawings.

1.05 PRODUCT DATA:

A. Submit the number of copies required in Article 1.04.B.1.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to this Project.

C. After review, distribute in accordance with Article 1.04 above and provide copies for Record Documents described in SECTION 01780 - Contract Closeout.

1.06 SOURCE OF SUPPLY AND SAMPLES:

A. As soon as practicable after Notice to Proceed, furnish for approval of the Engineer the proposed source of supply of materials to be utilized in the project and the samples required by the Specifications or requested by the Engineer. Unless otherwise indicated, submit not less than two identical samples of each type required. Pre-pay all shipping charges on samples. Materials or equipment for which samples are required shall not be used in the work until approved in writing by the Engineer.

B. Label each sample indicating:

1. Name of Project and Contract Number

2. Name of Contractor and Subcontractor

3. Material or equipment represented

4. Source

5. Name of producer and brand; include model number, style, color name, etc. if applicable.

6. Specification Section, Article or Paragraph

7. Location in project

C. Samples of finished materials shall have additional markings that will identify them under the finish schedules. Submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for the Engineer's selection.

D. Mail under separate cover letter in triplicate submitting each shipment of samples and containing information required in Article 1.04.B herein. Enclose a copy of this letter with the shipment and send a copy of this letter to the Engineer.

E. Approval of a sample shall be only for characteristics or use named in such approval and shall not be construed to change or modify any Contract requirements.

F. Certain samples may be tested by the Administration as specified. Approved samples not destroyed in testing will be retained by the Engineer. Materials and equipment incorporated in the work shall match approved samples. Samples not destroyed in testing and not approved will be returned to the Contractor at his expense, if so requested at time of submission.

G. Failure of any material to pass specified tests will be sufficient cause for refusal to consider, under the Contract, any further samples of the same brand and make of that material. The Administration reserves the right to disapprove any material or equipment which previously has proved unsatisfactory in service.

H. Samples of various material or equipment delivered on the site or in place may be taken by the Engineer for testing. Samples failing to meet Contract requirements will automatically void previous approvals of items tested.

I. When tests are required, only one test of each sample proposed for use will be made at the expense of the Administration. Samples, which do not meet Specification requirements, will be rejected. Retesting of additional samples will be made by the Administration at the expense of the Contractor.

1.07 MANUFACTURERS' INSTRUCTIONS:

A. When specified individual Specification Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, in quantities specified for Product Data (CDRL).

B. Identify conflicts between manufacturers' instructions and Contract Documents.

1.08 MANUFACTURERS' CERTIFICATES:

A. When specified in individual specification Sections, submit manufacturers' certificate to Engineer for review, in quantities specified for Product Data (CDRL).

B. Indicate material or Product conforms to or exceeds specified requirements. Submit supporting reference date, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on Material or Product, but must be acceptable to the Engineer.

1.09 OPERATIONS AND MAINTENANCE DATA:

A. In accordance with the project schedule and milestone sections of this document, unless other requirements are specified elsewhere, provide ten (10) copies and one CD of a manual containing all information pertaining to and necessary for the operation and maintenance of all equipment provided under the Contract to the Engineer for approval during PDR and FDR Phase of the Project.

B. Format, organization, and contents of the manual shall be as specified in the order of the Sections of the Special Provisions. [Include all information required in the individual section.]

1.10 PROGRESS PHOTOGRAPHS:

A. After construction operations have started at the site, have an average of ten color photographs taken each month until completion of the work. The actual number and location of views to be taken each month shall be as designated by the Engineer. The negatives and three prints of each photograph shall be submitted to the Engineer within ten days after taking (CDRL). If a digital camera is used, the camera must have at least 12 megapixels and in lieu of the negative, a JPG fine (1:4 compression) and a digital negative (DNG) produced using Abode's DNG converter are to be provided for each photograph.

B. Prints shall be standard commercial quality, 8 x 10 inches, on single weight glossy paper. Identify photographs with date, time, orientation and project identification in an information box, 1 $^{1}/_{2}$ x 3 $^{1}/_{2}$ inches in the lower right hand corner, typewritten and arranged as follows:

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION
MARYLAND TRANSIT ADMNISTRATION

CONTRACT NAME: _____
CONTRACT NO. _____
CONTRACTOR _____

PHOTOGRAPH NO. _____ DATE _____

(Information regarding view such as location, direction of sight and significant points of interest.)

C. Photographs shall be enclosed back-to-back in a double-faced plastic sleeve punched to fit standard three-ring binders. Enclose negatives in protective envelopes. JPG and DNG files can be provided on either CD-R or DVD media.

1.11 REQUEST FOR PROGRESS PAYMENT:

A. In accordance with Section GP-9 of the General Provisions, submit monthly requests for progress payment, based upon work accomplished during the previous month.

B. Support such requests by evidence that the work invoiced has been done.

1.12 ESTIMATED COST BREAKDOWN:

A. In accordance with Supplementary General Provisions, Article SGP-9.03, furnish a breakdown of Contract lump sum prices for which it is anticipated that partial payment will be requested by the Contractor.

B. Submit the estimated cost breakdown to the Engineer for approval at least 30 days prior to the anticipated partial payment request (CDRL).

1.13 CONTRACT DATA REQUIREMENTS LIST

B. Within ten (10) days after date of Notice to Proceed, the Contractor shall submit a complete Contract Data Requirements List (CDRL), with submittals gathered from all sections of the Contract Documents, and get it approved by the Engineer.

C. The project schedule shall include separate activities for all submittals in the CDRL.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 SUBMITTALS:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 01301

DOCUMENTATION AND TRAINING

PART 1: GENERAL

1.01 GENERAL DOCUMENTATION REQUIREMENTS

A. The Contractor shall deliver full and complete documentation in accordance with the requirements, deliverable schedule, and project plan.

B. Documentation shall provide sufficient description, detail, and illustration to support installation, configuration, operation, maintenance, and repair of the equipment and systems provided in the exercise of this Contract. The Authority Project Manager or designated representative shall be the sole judge of adequacy of documentation and documentation submittals.

C. The Contractor shall provide at Preliminary Design Review a complete listing of documentation to be provided in the exercise of these requirements. Included at minimum shall be the documentation title, table of contents, expanded outline, listing of drawings, illustrations, schematics, exhibits, and other such information so as to enable preliminary judgment upon the adequacy of the documentation.

D. The Contractor shall provide at Final Design Review a complete exhibit of draft documentation to be provided in the exercise of these requirements. This documentation shall be complete and accurate to the level necessary to facilitate review and, if appropriate, the approval of the equipment final design.

E. Delivery of final documentation shall be in accordance with the project plan, which shall specify dependencies, schedule, quantity, and location.

F. The execution of the Warranty shall require the Contractor to maintain documentation to the current revision, incorporating all engineering changes, modifications, changes, corrections, or updates.

G. The Authority reserves the right to reproduce documentation for its sole use and purpose.

H. Technical manuals shall comprehensively address all phases of system configuration, operations, maintenance, repair, and spare part provisioning. Include information for bench level troubleshooting and repair to the component level.

I. Training and support materials shall be provided to enable Administration personnel to operate, maintain and update the complete Non-Vital Request and Indication System. Training program shall include detailed instructions, demonstrations and supervised hands-on training.

J. Initial training shall be performed by the Contractor, who must then provide the Administration with the tools to conduct further, ongoing training after completion of Contract.

1.02 QUALITY ASSURANCE:

Provide qualified instructors who are thoroughly familiar with all subject material for each training session.

1.03 DOCUMENTATION SUBMITTAL REQUIREMENTS

A. Unless otherwise specified, all submittals shall be in accordance with Section 01300.

B. Preliminary documents shall be supplied prior to or concurrent with the delivery of the demonstration equipment. It will be acceptable if these documents are preliminary.

C. The documents supplied must be the latest version and be for the equipment delivered and installed. No documentation will be considered final until it has been reviewed and approved by the Authority Project Manager.

D. The final version of all documentation shall be provided on in electronic form suitable for use on a Windows™ based PC system. Alternative electronic forms may be substituted upon approval by the Authority.

E. For approval, submit 5 complete sets of technical manuals (CDRL).

F. After approval, Contractor shall supply 10 copies of each manual supplied under this Contract (CDRL). Also, each manual shall be supplied in an electronic form as specified by the Administration. The Administration may copy any and all material for its own use.

G. Training Program Materials (CDRL): Submit one complete reproducible set of printed training program materials and 25 complete copies. Submit 2 of each mock-up or model that shall become the property of the Administration.

H. Submit a Training Program Plan (CDRL).

1.04 SUMMARY OF MANUALS

A. General:

1. All manuals shall be prepared on a personal computer using an industry standard publishing system.

2. All manuals shall be properly indexed.

3. Manuals shall be designed for continuous, long-term service. Manuals shall lay flat when opened and permit adding and replacing pages.

4. Manual shall consist of 8.5 x 11 inch sheets bound in standard 3-ring loose-leaf type binders. The sheet binder holes shall be reinforced. Page guides shall be installed in the front and back of each binder to guide the sheets when closing.

   a. Foldout diagrams of illustrations may be employed with a maximum size of 11 x 17 inches. Title shall be visible when the sheet is folded.

   b. Covers shall be oil, grease, solvent, and wear resistant.

   c. The paper and ink shall resist smearing, fading and deterioration from age.

5. Manuals shall be written so as to be understood by a high school graduate with 2 years of experience in a related field but with minimal knowledge of railroad or transit operations. The writing shall be concise and free of ambiguities.

6. Manufacturer's standard manuals will be acceptable, subject to the approval of the Administration, if they deviate only slightly from the requirements specified herein.

7. Revisions to a manual shall be reflected in a revision index that is a part of each manual and revised with each manual update.

B. All manuals supplied as final documentation shall include all changes to any system up to the time of acceptance by the Administration. Revisions to final draft and approved manuals shall be recorded on a control list in the front of each manual.

C. The following is a summary of the principle documentation that shall be provided in the form of manuals, organized by the desired content.

Contractors recommending alternative organizational formats shall do so at the Preliminary Design Review. Irrespective of the summary and organizational format, all documentation shall provide sufficient description, detail, and illustration to support installation, configuration, operation, maintenance, and repair of the equipment and systems provided in the exercise of this Contract. To the extent possible, the Contractor will provide component level documentation for all Original Equipment Manufacturer (OEM) equipment provided by subcontractors and suppliers.

1. Manuals shall be specific to the features and functionality provided by the contracted system.

2. That portion of manuals related to the listing of parts shall be organized such that it is separate from its associated manual. This organization will permit reproduction and reference to the listing of parts without the requirement to reproduce or reference the complete manual.

3. That portion of manuals related to the specific description or illustration of security equipment or features, to the extent the information can be used to circumvent or defeat system security, or in the opinion of the Contractor may be used in such a manner, shall be identified by the Contractor. At the discretion of the Authority, the Contractor may be required to delete, remove, or separately organize such material.

1.05 OPERATING MANUAL

A. The operating manual shall provide information and instruction on the various operational controls and features of the various systems and equipments provided under this contract.

B. The manual shall be sufficient in description, detail, and illustration to provide full and adequate reference to the operation of the various systems and equipments provided under this contract and to the development of operator training programs.

1.06 OPERATOR REFERENCE

A. The operator reference shall provide summary information and instruction on the various operational controls and features of the various systems and equipments provided under this contract.

B. The manual shall be of suitable size and design so as to be conveniently carried and used by operators in the course of normal business activity.

C. The Operator Reference shall contain specific instructions in check-list form to address operational problem solving technique.

1.07 MAINTENANCE AND REPAIR MANUALS

A. The maintenance and repair manuals shall provide information and instruction on the maintenance of the various systems and equipments provided under this contract.

B. The manuals shall be sufficient in description, detail, and illustration to provide full and adequate reference to the diagnosis, testing, maintenance, repair, and replacement of the various systems, equipments, modules and components provided under this contract.

C. The manuals shall be sufficient in description, detail, and illustration to provide full and adequate reference for the development and support of maintenance training programs. Manuals shall contain diagrams, illustrations, schematics, parts listings, diagnostic and testing procedures, flow charts, and program code description as necessary to fully support maintenance functions.

D. Prepare maintenance and repair manuals for each subsystem or group of related equipment. Additional instructional material shall be provided in the form of film transparencies and videocassette tapes. Include in each manual:

1. General descriptions.

2. Theory of operation.

3. Block diagrams.

4. Schematic diagrams.

5. Wiring and cabling diagrams, including all interconnecting wire lists with source and destination descriptions for each wire.

6. Illustrations depicting equipment locations and layouts with appropriate nomenclature to facilitate maintenance.

7. Fault isolation procedures.

8. Preventive maintenance tasks and procedures, including recommended intervals.

9. Repair procedures.

10. Spare part requirements.

11. Maintenance test equipment lists.

12. Part lists with exploded views of assemblies as required.

13. Warning and precautions to be observed during maintenance actions.

14. Cleaning, including frequency, methods and recommended materials.

15. Testing requirements to return the repaired unit back into service.

16. Other information as necessary to ensure proper maintenance and repair.

1.08 TRAINING

A. Training Materials: Provide materials to support the training courses, including: instruction guide, training aids, student workbooks and operation and maintenance manuals. Twenty-five copies of the final version of trainee materials shall be provided. One final copy of the Instructor Guides shall be provided. In addition to these quantities, all printed materials shall be submitted in electronic form.

1. Instructor Guide: Provide Instructor Guides containing: course outline, agendas, objectives, lesson plans, training aids, presentation guidelines, suggested discussion questions, and criteria for measuring student performance.

2. Training Aids: Provide training aids, such as mock-ups, scale models, overhead transparencies. All training aids shall be of durable construction and become property of the Administration. Verify that all equipment or tools used during training are in good working conditions both before and after training sessions.

3. Student Workbooks: Provide student workbooks that include course objectives, a course agenda, schedule of sessions, copies of overhead transparencies, lecture outlines, and any additional printed material used during the course.

B. Class Lectures/Presentations: Provide experienced trainers who are knowledgeable about the subject matter. They must be able to answer questions and give detailed explanations and demonstrations. All presentations shall be made in English. To help Administration trainers become familiar with the content and delivery of the training, Contractor shall record their classroom presentations or provide staged recorded

versions, in DVD format. The Administration will furnish recording equipment. Contractor shall provide personnel to operate the camera.

Proof of qualification shall be one or more of the following:

1. Resume.

2. Certificate of diploma.

3. Curriculum vitae.

4. Documentary evidence of technical/instructional competence.

C. All training courses and products proposed by Contractor shall be subject to approval by the Administration. Drafts of materials shall be submitted for approval at periodic intervals in the design stage, first draft stage and final version. Final materials shall be submitted for approval at least 3 months prior to start of training.

D. Training shall be performed in the Administration's facility. Contractor shall use equipment provided as part of the Contract for training. The Administration will videotape all training courses for future use.

E. The Contractor shall determine the length of each training course based on system requirements and the following student qualifications:

1. Personnel to receive Operator Training shall be educated to high school graduation level and shall have had a minimum of 12 months experience as an operator, trainer, or supervisor with the existing control system.
2. Personnel to receive Administrator Training shall be educated to high school graduation level and shall have had a minimum of 12 months experience as a system administrator, trainer, or supervisor with the existing control system.
3. Personnel to receive Maintenance Training shall be educated to high school graduation level and shall have had a minimum of 12 months experience as a system maintenance technician, trainer, or maintenance supervisor of the existing system.

F. Contractor shall conduct the required training at MTA facilities in Baltimore, at the scheduled times and location designated by the Administration consistent with the approved Training Plan. The full complement of training courses shall be conducted over time to accommodate shift personnel, vacations and make-up sessions. A detailed schedule for the delivery of all training shall be included in the Project Management Plan and Schedule and reported on during the regularly scheduled status meetings. All training shall be completed prior to the new Yard Route Pushbutton System being placed in service. All training shall

be completed sufficiently before the completion of the FAIT to allow MTA to train all their personnel. After the training of MTA's trainers has been completed, MTA will need to train approximately 30 maintenance personnel, 70 train operations personnel and 3 safety personnel. The training shall include, but not be limited to the following:

1. **Train Operator Training** shall be given to Light rail Train Operator and Safety personnel: Operator Training - 2 separate course presentations, 15 students per session maximum.

2. **System Administrator and Maintenance Training** shall be given to MTA Trainers and shall include all necessary information to allow MTA to manage the system, reconfigure the system and reload software. Training shall include but not be limited to: software review, sequence of operation and flowcharts; modification of control programs and databases; add/delete/modify data points; use of diagnostics and system maintenance procedures; review of initialization; upload/download and off-line archiving of all system software; review of all administration topics presented in the Maintenance Manual: System Administrator and Maintenance Training – 1 separate course presentations, 5 students per session maximum.

3. **Maintenance Training** Subjects shall include all system hardware, software, database and interface maintenance of PLCs, maintenance test panels, pushbuttons, wheel detectors and all control circuits including interface circuits with the existing switch operating circuits and Location 94N. Review of all topics in the System Maintenance Manuals: Maintenance Training – 3 separate course presentations, 10 students per session maximum.

G. Training Report - Upon completion of each training program, the Contractor shall prepare and deliver a training report which shall summarize the results of the training program, including a list of attendees, course evaluation form, and recommendations for follow-up training or modification to the curriculum.

H. Training Plan - Contractor shall provide for review and approval a Training Plan which shall address Operator Training, Supervisor Training, System Administration Training and Maintenance Training. The Training Plan shall include at a minimum:

1. A description of all training courses including identification of the purpose and goals of each course, the Administration personnel who should attend each course, duration of the course, type of training (presentations, hands on training) and identification of the facility and training equipment provided by the Contractor (e.g., lecterns. overhead projectors, televisions, video cassette recorders, specific enhanced Yard Route Pushbutton System Training and associated hardware elements,

etc.).

2. A list of classroom instructors who shall conduct the training and a description of their skills, experience and qualifications.
3. Individual course curricula, course materials, manuals, study guides and workbooks.
4. Course critique and evaluation forms for students.
5. Post-training and or on-the-job technical reference guides.
6. A detailed schedule for the delivery of all training courses.

After receipt of the Training Plan, the Administration will formally comment on its content. Contractor shall make appropriate changes to the Training Plan and resubmit it for review and approval.

I. Training Program

After approval of the Training Plan, the Contractor shall conduct the specified training.

1. The training program shall be implemented through the use of formal classroom training and/or other forms of presentation as recommended by the Contractor.
2. The curriculum shall be designed so that each group of trainees shall be trained in the full repertoire of system commands which they may have to use in the course of performing their designated functions.
3. Students shall be provided with complete sets of training materials and operating manuals during the training sessions, which they shall retain for use on the job at the completion of training.
4. Formal training shall also include a comprehensive student testing program for determining that the intended training has been successfully imparted.
5. Contractor shall conduct the required training at scheduled times and locations designated by the Administration. The full complement of training courses shall be conducted over time to accommodate shift personnel, vacations and make-up sessions.

J. Training Materials

Contractor shall provide the Training Manuals and any other associated course materials, study guides and workbooks, as described in the approved Training Plan. These manuals shall be for instructional use during the Training Program, for study and for refresher use to provide training of all the features and functions of the Yard Route Pushbutton System Integrated System during normal and emergency operations. These

manuals shall also be for Administration use to train new operators, supervisors, system administrators and maintenance staff on an ongoing basis.

K. Qualifications of Trainer

1. Training may be conducted by Contractor, the Contractor's subcontractors, and/or original equipment manufacturers.
2. Provide qualified instructors with five or more years of product training experience and complete technical and hands-on knowledge of the material covered in the courses.
3. Submit qualifications of any subcontractor utilized to provide training and resumes of all proposed instructors for approval.

1.09 SUMMARY OF OTHER DOCUMENTATION

A. The following is a summary of other principle documentation that shall be provided in addition to that provided as manuals. The requirements are organized by the desired content. Contractors recommending alternative organizational formats shall do so at the Preliminary Design Review. Irrespective of the summary and organizational format, all documentation shall provide sufficient description, detail, and illustration to support installation, configuration, operation, maintenance, and repair of the equipment and systems provided in the exercise of this Contract.

B. All documentation shall be specific to the features and functionality provided by the contracted system.

C. That portion of documentation related to the specific description or illustration of security equipment or features, to the extent the information can be used to circumvent or defeat system security, or in the opinion of the Contractor may be used in such a manner, shall be identified by the Contractor. At the discretion of the Authority, the Contractor may be required to delete, remove, or separately organize such material.

1.010 FIRMWARE DOCUMENTATION

A. If certain functions are implemented in firmware, The Contractor shall provide its documentation according to the following guidelines:

1. If a portion of an overall software function is implemented as firmware, document that portion as software.
2. If firmware is provided as a programmed equivalent of a hard-wired device or hardware interface logic, document that firmware as hardware.

1.011 SYSTEM DOCUMENTATION:

A. System Functional Description Document

1. Provide an overview of the hardware configuration and indicate the functional responsibilities of all major hardware subsystems. Include high-level hardware configuration block diagrams and software subsystem block/flow diagrams.

B. Hardware Documentation to include the following:

1. Configuration block diagrams
2. Physical planning/site preparation manuals that contain detailed mechanical drawings of all cabinets, consoles, peripherals, and related hardware indicating mounting details, clearance requirements, and environmental restrictions including all hardware electrical power requirements.
3. Reference manuals and instruction books for all hardware, including hardware user manuals and, where applicable.

C. Software Documentation to include the following:

1. 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
2. Reference manuals and documents for programmers or other MTA personnel to use when developing new programs or maintaining existing programs related to the supervisory alarm monitoring and control system.
3. Licensed softcopies of all application, utilities and other software supplied under this contract shall be submitted. For custom software programs, compiled and ready to install copies of such custom programs shall be provided to the Administration.

1.012 LISTING OF TOOLS

A. The contractor shall provide a list of all special or custom tools or instruments required to install, maintain, or adjust any component in the contracted system. The contractor shall also provide a list of suppliers of required special or custom tools or instruments.

1.013 BILL OF MATERIAL

A. A complete Bill of Material shall be provided that shall include a unique part number, description, generic name and generic part number for each component in the contracted system. The Bill of Material shall include identification to level of specific diode, capacitor, or screw. Diagrams and drawings shall identify each system component and shall call out each component with the unique part number as referenced in the Bill of Material. Sub-component detail shall be provided for Contractor-manufactured equipment. Sub-component detail of commercial equipment such as computers and peripherals, at the discretion of the Authority, may be limited to board or major component level.

1.014 LISTING OF SOURCES

A. The Contractor shall provide by listing sources for purchasing components and parts that are commercially available, other than from the Contractor. Components and parts not so listed shall be considered by the Authority to be proprietary and available by single source.

1.015 COMMUNICATIONS PROTOCOLS

A. Contractor will provide full and complete documentation of the communications protocol and message set information between any contracts provided the various systems component and any other system or external component, regardless of whether the component is provided under the terms of this Contract or other Authority contract. The documentation shall be sufficient in content and detail to afford the Authority the ability to interface and communicate in the same manner to an appropriately compliant component for the purpose of affecting operational control or data exchange. Unless otherwise documented, the failure of the Authority to affect operational control or data exchange shall be a failure of the documentation.

1.016 PRINTED CIRCUIT BOARDS

A. The Contractor shall provide a schematic diagram for all printed circuit boards. The Contractor shall provide a parts layout for each printed circuit board, specifically calling out each component, mechanical or electrical, and showing its location.

B. The Contractor shall provide drawings showing the location of all the traces all surfaces of each printed circuit board.

1.017 MICROPROCESSOR PROGRAMS

A. The Contractor shall provide documentation for each system and subsystem microprocessor program related to the various systems and equipments provided under this contract.

B. Documentation provided shall be sufficient to allow the Authority, without reliance upon the original Contractor, to modify the contractor supplied system and equipments.

C. The documentation for each applicable microprocessor program shall be complete and comprehensive to include, but not limited to, fully commented and complete source code listings, and fully complete block diagrams or software design narrative sufficiently descriptive to define system code, sub-routine, and logic operations.

1.018 LISTING OF MESSAGES

A. The Contractor shall provide a complete listing of system messages not otherwise defined in provided documentation. Messages shall include, but not be limited to, displays, indications, tones, status conditions, responses, or actions whether decoded or available for decode.

PART 2: PRODUCTS

Not used

PART 3: EXECUTION

Not used

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Operations and maintenance manuals will be measured on a lump sum basis.

B. Training will be measured on a lump sum basis including all associated training plans and training materials.

4.02 PAYMENT:

A. Operations and Maintenance Manuals will be paid for at the contract lump sum price for Operations and Maintenance Manuals.

B. Training will be paid for at the contract lump sum price for training.

END OF SECTION

SECTION 01310

COORDINATION AND MEETINGS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section describes the various administrative interfaces between the Contractor, the Administration and others.

B. Related Work Specified Elsewhere:

1. SECTION 01130 Construction Procedures

2. SECTION 01150 Interface Requirements

1.02 UTILITY NOTIFICATIONS:

A. Prior to performing excavation or grading at any location, contact the Utility Services Protection Center, "Miss Utility", 1 800 257 7777. This contact shall be made between the hours of 7:00 am and 5:00 pm, Monday through Friday, excluding holidays and at least forty eight (48) hours in advance of the proposed work (7 days notice for known BGE facilities). No work shall be commenced until the utility companies affected have properly located their facilities to prevent damage thereto. The Contractor shall certify to the Engineer that the Utility mark-out has been completed prior to the start of the Contractors work.

1.03 COOPERATION WITH OTHER CONTRACTORS:

A. Pursuant to General Provisions Article GP-5.06, the Contractor shall confer with and coordinate through the Engineer, this Contract's work with that of all other contractors working in the project area. Subject to the Engineer's approval, the Contractor shall plan and execute construction operations in a manner that will afford these contractors maximum freedom of movement. The Contractor will be held responsible for extra costs incurred by other contractors as the result of any activity that delay or hinders their work.

B. The Contractor shall cooperate with others while on adjoining or overlapping work as necessary. Such cooperation shall include:

1. Arrangement and conduct of work.

2. Storage and disposal of materials, etc., by each in such manner as to not interfere with or hinder the progress of the work being

performed by other Contractors. Contiguous work shall be joined in an acceptable manner.

1.04 PROGRESS MEETINGS:

A. Contractor shall schedule and administer meetings throughout progress of the Work at weekly intervals, maximum. The Contractor will prepare the agenda, record minutes and distribute the approved Engineer's copies within two days to the participants, and those affected by the decisions made as provided by the Engineer.

B. The Engineer will make approve the arrangements for meetings, meeting agenda, meeting minutes and distribute lists copies within three days for the Contractor, and provide the list of participants, and those affected by the decisions to be made.

C. Attendance Required: Engineer, Job Superintendent, and major Subcontractors and suppliers, as appropriate to agenda topics for each meeting. The list of attendace will be modified by Engineer as appropriate.

D. Agenda: (to be modified by Engineer as appropriate)

1. Review of minutes of previous meetings.
2. Review of Work progress.
3. Field observations, problems and decisions.
4. Identification of problems that may impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-site fabrication and delivery schedules.
7. Maintenance of progress schedule.
8. Corrective measures to regain projected schedules.
9. Planned progress during succeeding work period.
10. Coordination of projected progress.
11. Maintenance of quality and work standards.
12. Effect of proposed changes on progress schedule and coordination.
13. Other business relating to Work.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 COORDINATION AND MEETINGS:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 01360

PROJECT SAFETY, HEALTH, AND SUBSTANCE ABUSE PROGRAM

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies the general requirements for the Contractor's on-site Safety, Health, and Substance-Abuse Program (SHSAP). In the execution of this Contract, the Contractor shall be solely and completely responsible for the safety of persons and property affected by the Contract work and for maintaining a substance-abuse free work place. In addition to the requirements stipulated in General Provisions, implement and maintain this program to protect its and subcontractor's employees engaged in Contract work, the public against injury and loss, and completed portions of the work and other public and private property against damage and loss.

B. Within five (5) calendar days after issuance of Notice of Intent to Award, the Contractor shall submit, at a minimum, a written General Safety and Health Plan to the Administration (CDRL). Within five (5) calendar days after Notice to Proceed, the Contractor must submit a complete "Project Specific Safety and Health Plan" for approval (CDRL). Plans shall conform at a minimum to the requirements specified in Article 1.02 herein and the requirements outlined in Appendix F "Contractor Safety and Health Plan Guidelines – 2011". Where a conflict in requirements occurs, the document in Attachment 2 shall be followed. The document in Attachment 2 details submittal requirements that shall be followed in conjunction with overall submittal requirements of Section 01300. Payment of Mobilization allowance is contingent upon submission and approval of the Contractor's Safety and Health Plan.

C. The Resident Engineer reserves the right to deny the use of unsafe procedures or equipment that in the Resident Engineer's opinion could create a hazard or cause serious injury or property damage.

D. Related Work Specified Elsewhere:

1. Section 01000 – Summary of Work

1.02 PROGRAM REQUIREMENTS:

A. Comply with all pertinent provisions of the Maryland Occupational Safety & Health Law and Regulations; 29 CFR, Ch. XVII, Part 1926, Safety and

Health Regulations for Construction and 29 CFR 1910 – General Industry Regulations.

B. Describe procedures, equipment, and medical facilities to be furnished by the Contractor that are necessary for supplying first-aid service, including standing arrangements for the removal to hospital for treatment of any person injured while engaged in work.

C. Describe safety orientation and training programs for supervisors and employees relative to overall safety and specific job exposures.

1. At a minimum, include in the Program: eye protection, head protection, hearing protection, respiratory protection, housekeeping, fire prevention and protection, first aid, emergency procedures, toxic/hazardous materials and substances, material handling, and electrical safety.

2. Provide additional safety training as necessary for unfamiliar or hazardous tasks.

3. Complete training prior to an employee commencing work.

D. Incorporate substance-abuse procedures as specified in Article 1.04 herein.

1.03 ON-SITE PROGRAM PROCEDURES:

Incorporate the following requirements into the SHSAP and strictly adhere to them at all times:

A. Accident Prevention and First-Aid Provisions:

1. Prior to the start of construction, submit to the Resident Engineer written certification that the appropriate provisions of the documents referenced in Article 1.02 A herein, training, and other safety measures have been met to prevent injury or loss to workers, other persons, and property (CDRL).

2. Provide, erect, and maintain wherever necessary, all barricades, suitable and sufficient lights, danger signals, signs, and other warning devices within the job site for the protection of personnel and completed portions of work.

3. Ensure that all workers are provided with and wear, as appropriate, protective clothing and other safety devices such as hard hats,

protective masks, anti-noise ear plugs, safety goggles, and/or insulated gloves at all times in the performance of their tasks.

4. Be prepared at all times to render appropriate first-aid assistance to accident victims until professional ambulance and rescue personnel and equipment are available.

5. Maintain a full complement of first-aid equipment and supplies and have it readily available at all times. Immediately replenish all supplies after using.

6. Include samples of forms for recording and reporting accidents in accordance with Department of Labor regulations. Include name of insurance carrier on forms.

B. Fire Prevention and Protection (FPP):

1. Store all flammable and hazardous materials in an isolated, protected area in a neat, orderly manner so as not to jeopardize worker's safety or completed portions of the work. Ensure that sufficient fire extinguishing equipment appropriate for the type of materials stored is readily available near the storage area for instant use.

2. On a daily basis, clean up and dispose off-site all refuse, rubbish, scrap materials, and debris caused by the day's operations to permit safe movement of workers and fire equipment at all times.

1.04 SUBSTANCE-ABUSE:

A. Definitions:

1. "Controlled" substance means a controlled substance in Schedules I through V of Section 202 of the Controlled Substance Act (21 U.S.C. 812) and as further defined in 21 CFR 13008.11 through 1308.15. Controlled substance as used herein includes alcohol.

2. "Conviction" means a finding of guilt (including a plea of nolo contendere) or imposition of sentence, or both, by any judicial body charged with the responsibility to determine violations of the Federal or State criminal drug statutes.

3. "Criminal Drug Statute" means a Federal or non-Federal criminal statute involving the manufacture, distribution, dispensing, possession, or use of any controlled substance.

4. "Substance-abuse free workplace" means a site for the performance of work done in connection with this Contract at which Contractor's employees are prohibited from engaging in the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance.

5. "Employee" means a Contractor's employee directly engaged in the performance of work under this contract.

B. Provide a policy statement that the unlawful manufacture, distribution, dispensing, possession, or use of a controlled substance is prohibited in the Contractor's workplace, and specifying the actions that will be taken against employees for violations of such prohibition.

C. As a condition of hire, require pre-employment substance abuse testing. Such test will include tests for controlled substances. Have an approved medical facility conduct all such tests, and a National Institute of Drug Abuse (NIDA) approved laboratory process them.

D. Provide a procedure for mandatory substance-abuse tests after any accident or other unusual circumstance in which a violation of substance-abuse rules is suspected.

E. Establish a substance-abuse free workplace awareness program to inform employees of the following:

1. The dangers of substance abuse in and away from the workplace.

2. The Contractor's policy of maintaining a substance abuse free workplace.

3. Any available substance-abuse counseling, rehabilitation, and employee assistance programs.

4. The penalties to be imposed upon employees for substance-abuse violations occurring in the workplace.

F. Provide all employees engaged in performance of the Contract with a copy of the policy statement regarding the substance-abuse program. Have each employee submit a signed affidavit acknowledging receipt of and having read and understood the provisions of the substance-abuse program.

G. As a condition of continued employment, require that each employee abide by the terms of the statement and notify the employer of any criminal

substance-abuse statute conviction no later than five working days after such conviction. Failure to comply with this requirement will result in immediate termination of employment.

1. Notify the Resident Engineer within ten working days of notification of any such convictions.

2. Within 30 days of receiving notification, impose the following sanctions or remedial measures on any employee convicted of a substance-abuse violation:

   a. Appropriate personnel action against such employee, up to and including termination; or

   b. Require such employee to participate satisfactorily on substance abuse assistance or rehabilitation program approved for such purposes by a Federal, State, or local health, law enforcement, or other appropriate agency.

H. Require subcontractors to establish and implement a substance-abuse program that incorporates the requirements identified herein.

I. Certification of Compliance:

1. Submit to the Resident Engineer certification that the Contractor has implemented and is properly executing the substance abuse program (CDRL). Include the following:

   a. Legible copies of billings from the laboratory performing specimen analysis.

   b. Number of employees hired.

   c. Number of employees tested.

   d. Number of positive and negative test results.

2. Ensure that employees' confidentiality is maintained in regard to the certification. Do not include names, addresses, social security numbers, job titles, or other identifying data of personnel tested.

3. The Resident Engineer reserves the right to verify individuals assigned to perform the work under this Contract against individuals listed on billings from the laboratory performing the specimen analysis.

1.05 EMERGENCY CONTACT PERSON:

A. Designate a responsible individual to be available to respond to emergency calls and provide the Resident Engineer, MTA Police, MTA Office of Safety, Quality Assurance and Risk Management and all emergency response agencies in the area with the individual's name and telephone number at which that person may be reached at all times. Assign to such person full authority and capability to mobilize forces promptly as required to respond to an emergency and to protect the public.

1.06 MTA SAFETY REQUIREMENTS:

A. Adhere to all Administration safety rules and regulations regarding work on the system. Comply with all requirements of MTA's Contractor Safety & Health Plan Guidelines dated 2011.

B. Prior to any work on the MTA's Central Light Rail Line, Contractor personnel must complete and pass MTA's Railroad Worker Protection Training Course. This course is provided at no cost to the contractor and is valid for one year.

C. Supervisors, or person in charge of work site, will be required to attend and pass an additional one day "On Site Coordinator" (OSC) training for a total of two days. An OSC presence is required whenever work is being performed. This course is provided at no cost to the Contractor and is valid for one year.

D. Any section of track removed from service for maintenance, modification, repair, Construction, or recovery activities will incorporate a Work Block to the nearest Fixed Signal or Chain Marker.

E. All Work Block / Red Tags will have one qualified individual designated as the On Site Coordinator (OSC). The OSC will have all responsibilities as defined in the RWP Manual.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. All work under this section will not be measured separately for payment.

4.02 PAYMENT

A. The work under this section will not be paid for directly, but will be considered incidental to the appropriate work item it pertains. The document for on-site Safety, Health, and Substance-Abuse Program (SHSAP) and its maintenance throughout the project duration will be considered incidental to Bid Item “Mobilization” in the Unit Price Schedule.

END OF SECTION

SECTION 01450

QUALITY ASSURANCE AND QUALITY CONTROL

1.01 DESCRIPTION:

A. This Section specifies the Quality Assurance/Quality Control (QA/QC) requirements for the work performed under this Contract. These requirements encompass all actions involving selection of material sources and suppliers, inspection and testing of materials and samples, work placement procedures, workmanship, equipment calibration, use of Certificates of Compliance, implementation of procedures for audit, surveillance and corrective action, inspection, testing and commissioning. Additional QA/QC requirements are specified in individual sections of Special Provisions and Technical Provisions of the Contract Specifications.

B. Related Work Specified Elsewhere, but not limited to, the following:

1. G. P. – Section 6 – Control Of Material
2. Section 01000 – Summary Of Work
3. Section 01130 – Construction Procedures
4. Section 01300 – Submittals
5. Section 01600 – Products
6. Section 01780 - Contract Close Out
7. Section 17251 – Tests and Inspections

1.02 QUALITY ASSURANCE/QUALITY CONTROL PLAN:

A. It shall be the responsibility of the Contractor to provide and maintain a Contract Quality Control Plan (CQC Plan) for all work performed under the Contract. This requirement is independent of any acceptance inspection and testing performed by the Engineer and /or his testing agencies.

The CQC Plan shall conform to the requirements of this Special Provision Section and shall be designed and administered to assure that the Contractor’s work, including work performed by the Contractor’s suppliers and subcontractors, will be in full compliance with the latest version of applicable codes, special provisions, technical specifications and plans under the contract with respect to materials, workmanship, construction, installation, finish, functional performance, testing, commissioning and identification. Further the CQC Plan shall encompass

all actions involving selection of construction/installation material sources and suppliers, on-site and off-site fabrication of Contractor-furnished items to be included in the work, on-site and off-site production of construction materials, inspection and acceptance of owner furnished materials, work placement procedures, workmanship, inspection, testing and commissioning.

B. **Within seven (7) calendar days after issuance of Notice to Proceed** (NTP) for the Contract, the Contractor shall submit an "**Interim**" CQC Plan to the Engineer for approval. The interim plan shall cover all work to be performed under the Contract during the first sixty (60) calendar days of work. (CDRL)

Further, within thirty (30) calendar days after the issuance of the NTP, the Contractor shall submit a "**Detailed**" CQC Plan to the Engineer for approval. The detailed plan shall cover all work to be performed under the Contract. (CDRL)

The submission of the CQC plan shall be considered incidental to the bid item-Mobilization. The progress payments due to the Contractor may be withheld if the Contractor fails to submit conforming CQC Plans as scheduled herein.

C. With its Interim CQC Plan submission, the Contractor shall identify and designate a qualified individual (CQC Plan Manager) who shall be responsible for overall development and administration of the CQC Plan and submit the CQC Plan Manager's qualifications to the Engineer for approval. The CQC Plan Manager shall report directly to an executive officer of the Contractor's company and shall have the necessary authority to discharge his/her responsibilities. The CQC Plan Manager shall visit the project site on regular basis to assure proper administration of the CQC Plan.

For contracts in the amount of five million dollars ($5,000,000) and above, the CQC Plan Manager shall be at the project site on a full-time basis throughout the duration of the Contract and shall have no responsibilities other than those required by this Special Provision. However depending on the nature and complexity of the work to be performed under the Contract and/or instances of non-conforming work, the Engineer may require the CQC Plan Manager to be at the project site on a full time basis for contracts in the amount less than five million ($5,000,000) dollars.

D. With the interim CQC Plan submission, the Contractor shall identify qualified individuals and firms responsible for inspection and testing of on-site work (CQC Plan staff) and submit their qualifications to the Engineer for approval. The CQC Plan staff shall be sufficient to inspect and test all items of work under the Contract and report directly to the CQC Plan Manager.

For contracts in the amount of five million dollars ($5,000,000) and above, the CQC Plan staff shall be at the project site on a full-time basis throughout the duration of the Contract and shall have no responsibilities other than those required by this Special Provision. Additionally for contracts in the amount of five million dollars ($5,000,000) and above CQC Plan staff shall include and identify appropriate testing personnel for each major discipline of work performed under the Contract. These major disciplines include, but are not limited to, civil, structural, mechanical, electrical, systems engineering, and specialty work.

E. The Contractors **Interim CQC Plan** must include as a minimum the following:

1. An organization chart showing the Contractors corporate organization that is involved with the on-site operations.

2. The Contractors on-site organization chart including a quality control organization showing the proposed CQC Plan Manager and CQC Staff.

3. Authority, duties and responsibilities of quality control personnel. A copy of the letter of direction to the Contractor's representative and CQC staff, which defines their duties, responsibilities, and delegated authorities, shall be provided to the Engineer.

4. Operational procedures for accomplishing and reviewing work, supervision, inspection, tests, certifications, documentation of QA/QC activities, including those of subcontractors for all on-site and off-site work under the contract.

5. Procedures for indoctrination and instruction of quality control personnel, construction supervisors, foremen, subcontractors and suppliers.

6. The coordinating procedures and authorities concerning the work activities performed off-site and not under the direct supervision of CQC Plan Manager.

7. A detailed test matrix and inspection schedule keyed to the individual Special Provisions and Technical Provisions of the Contract and covering the work to be performed during the first Sixty (60) calendar days from NTP.

F. The Contractor's **Detailed CQC Plan** submission shall include the following:

1. A detailed schedule/matrix of control testing and inspection keyed to the individual Special Provisions and Technical Provisions of the Contract and covering each item of the work. The Engineer

shall approve the format of the test matrix. The test and inspection schedule shall cover all work to be performed under the Contract, including both on-site and off-site fabrication.

Inspection and test records shall include, but not limited to, the factual evidence that tests have been made, the applicable type and number of tests, the dates and results of the tests, nature and number of observations made, the number and type of deficiencies found and proposed corrective actions to be taken. All records shall provide identification and signature of the individual in charge of the inspection, test, or other QA/QC activity. These records shall be certified by the CQC Manager and include, as a minimum, the results of:

a. Inspection results, observations, conclusions and recommendations.

b. Testing with reference to set-up conditions, observations and concerns.

c. Fabrication procedures and controls.

d. Identity of the Personnel present and their certification.

e. Discrepant material details (including disposition records).

The legible copies of these records must be furnished to the Engineer daily. The records shall cover all work performed subsequent to the previously furnished records and shall be verified by the CQC Plan Manager.

2. A minimum of three phases of inspection to be performed by the CQC Staff for all definable items of work. The phases are:

a. Preparatory inspections shall be performed prior to beginning of each item of work and shall include a review of Contract requirements and CQC Plan test and inspection schedule mentioned above. Preparatory inspections shall include a physical examination of materials and equipment to assure that they conform to approved shop drawings or submittal data and are in required quantities to proceed with the work.

b. Initial inspections shall be performed as soon as a representative portion of the work has been accomplished. Initial inspections shall verify compliance with Contract requirements, establish acceptable levels of quality and workmanship, review quality control testing and confirm

that defective, damaged or unapproved materials are not incorporated into the work.

c. Follow-up inspections shall be performed regularly by CQC Staff to assure continued compliance with the Contract requirements and established levels of quality and workmanship.

The Engineer shall be notified at least forty-eight (48) hours in advance of each preparatory and initial phase inspection. Additionally, the CQC Plan Manager shall insure that all phases of inspection are made a matter of record in the CQC Plan documentation.

3. The CQC Plan shall provide well-defined procedures and forms to include, but not limited to the following:

a. Identifying and evaluating quality-related problems.

b. Recommending solutions to quality-related problems and verifying that those problems are resolved.

c. Controlling further fabrication, delivery, or installation of nonconforming or deficient item(s) until disposition instructions have been obtained.

d. Conducting quality inspections, surveillance and compliance audits of subcontractors, suppliers / manufacturers on a scheduled and unscheduled basis.

e. Maintaining quality control reports, approved shop drawings and submittals, as-built drawings, changes to the drawings and specifications.

4. The CQC Plan shall also provide written procedures to include, but not be limited to:

a. Control of subcontractors, manufacturers /suppliers.

b. Production and process quality control.

c. Discrepant and nonconforming material control.

d. Functional testing.

e. Calibration and/or certification of Measuring and Test equipment

f. Shipping and receiving inspection of materials.

g. Procedures necessary to meet the requirements described under Contract Special Provision Section 01780 - Contract Close Out.

5. Approval of the Contractor's CQC Plan shall not relieve the Contractor of its responsibility to comply with the Contract requirements. The CQC Plan shall be revised or updated as directed by the Engineer. No additional cost or time extensions will be allowed for the Contractor's re-submission of rejected Interim or Detailed CQC Plans or for revising or updating of the detailed CQC Plan during the course of the contract, as directed by the Engineer.

1.03 SOURCE OF MATERIALS:

A. In accordance with General Provision Section GP-6 – Control of Material; the Contractor shall notify the Engineer in writing of sources from which he proposes to obtain material requiring approval, certification, or testing indicating details and characteristics.

B. Notification shall be made as soon as possible after the NTP for the Contract and at-least thirty (30) days prior to the intended usage date of that material. (CDRL#44).

1.04 CALIBRATION AND CERTIFICATION:

A. The CQC Plan shall include the procedures to provide and maintain gauges; measuring devices and test equipment necessary to assure that the article conforms to Contract requirements. These devices shall be calibrated in accordance with national standards and certifications. Calibration certificates shall be maintained current and submitted to the Engineer. Any equipment exceeding its required re-calibration date or that becomes damaged or otherwise unreliable, shall be isolated, tagged or marked to prevent its use without written permission of the Engineer.

1.05 MANUFACTURING CONTROL:

A. The CQC Plan shall include methods for ensuring that all machining, wiring, shaping, and all other basic processing, fabrication and production operations of any type are accomplished under controlled conditions, including documented work instructions, certified personnel, adequate production equipment, and any special working environment.

1.06 INSPECTION AND TEST STATUS:

A. The CQC Plan shall include methods for ensuring that all required inspections and tests are performed and that the status of each work product, material item's inspections/tests is known. Identify nonconforming work product and material items by physical segregation

and status indicators such as tags, markings, serialization, stamps, and/or inspection records. The identification system used shall ensure that only those work items that have passed inspection shall be used, shipped, or installed. The nonconforming work product and material items shall be removed from the project site and storage areas as soon as possible.

B. Work products, materials and/or equipment manufactured or assembled under this Contract shall be accepted for use or released for shipment, as appropriate, when the following conditions(s) have been met.

1. After inspection and/or release by the Engineer and/or certification by the Contractor that the work product or material item is complete and in compliance with the Contract specifications.

2. Upon request for acceptance or a release for shipment submitted by the Contractor and supported by a satisfactory inspection report or certification of compliance accompanied by certified copies of test data. The certificate of compliance shall clearly identify the work product or material item covered by the certificate and shall also contain the test date and the name and address of the organization performing the require tests, as applicable.

C. Supplies, services, materials, and products procured from suppliers and subcontractors shall conform to the Contract requirements and the approved CQC Plan. Inspect all supplies, materials, services, and products upon receipt.

1.07 NONCONFORMING ITEMS:

A. The CQC Plan Manager shall take prompt action to correct conditions that have resulted or may result in nonconforming materials, parts, components, installations or functions/operations. The CQC Plan Manager shall document the nonconforming work and efforts to correct the deficiencies and prevent its occurrence in future. The CQC Plan shall provide for:

1. Maintaining an effective and positive system for controlling nonconforming work product and material item(s) including procedures for identification, segregation, removal and disposition. Document the corrective actions and submit to the Engineer for approval.

2. Ensuring that all nonconforming items(s) shall be positively identified to prevent unauthorized use, shipment, or intermingling with conforming items. Disposition for the use or repair of nonconforming items shall require the Engineer’s approval.

B. If the Contractor's work does not conform to the requirements of the Contract documents, the Engineer may issue a "Corrective Action" or " Nonconformance Report" to the Contractor. The Contractor must correct all deficiencies or otherwise respond to the report within seven (7) calendar days of issuance of report by the Engineer. The Contractor shall not build or conceal any feature of the work containing uncorrected defects. The Engineer may withhold monies due to the Contractor until the deficiencies are corrected or nonconformance issues resolved to the satisfaction of the Engineer.

C. If the Engineer determines that the CQC Plan and/or its administration are deficient in identification and correction of nonconforming work, the Engineer shall issue a "CQC Plan deficiency notice" identifying the specific deficiencies and required corrective actions. The Engineers corrective actions may include modification of the CQC Plan, replacement of the existing CQC Staff or supplementing of the CQC Staff, all at no additional time and cost to the Administration. The Contractor shall correct all the deficiencies as directed in writing by the Engineer. The Engineer may withhold monies due to the Contractor until the deficiencies are corrected.

1.08 HANDLING AND STORAGE:

A. The CQC Plan shall ensure that proper instructions are provided and followed for handling, storage, preservation, packaging, and shipping to protect the quality of products and to prevent damage, loss, deterioration, degradation, or substitution of products. Means shall be provided for any necessary protection against deterioration or damage to products in storage and handling.

1.09 UNACCEPTABLE WORK PRODUCTS AND MATERIAL ITEMS:

A. Work products or materials represented by installations or samples taken and tested in accordance with the specified test and failing to meet required values shall be considered to be defective regardless of prior tests or approvals.

B. Unless otherwise allowed by the Engineer, as set forth below, defective work products or material items shall be removed from the site as specified in the General Provisions for condemned material and with any tags, stamps or other markings implying conformance with specifications removed or obliterated.

C. Where defects can be corrected, the Contractor may propose corrective action in accordance with the manufacturer's recommendation or by other means as is deemed appropriate by the Engineer. The Engineer may approve the corrective action but does not assume responsibility for the

success thereof. Re-inspection and/or re-test may be made to determine acceptability of the material after corrective measures have been taken.

D. The cost of replacing, correcting and/or removal of defective work products or material items and of re-installation and re-testing replaced or replacement work products or materials shall be the responsibility of the Contractor.

E. The cost of repairing or replacing other work products or materials damaged by the installation, correction, and/or removal of defective materials is the responsibility of the Contractor.

1.10 ACCEPTANCE TESTING:

A. Acceptance testing is the testing of materials prior to their use in the work and also any testing deemed necessary by the Engineer for acceptance of the complete work. The Contractor will perform acceptance testing of materials and workmanship at the direction of the Engineer, in accordance with the Contract Documents. The Engineer reserves the right to request additional testing at any time to determine conformance with the Contract requirements.

B. Acceptance testing is not to be considered as a replacement for control testing conducted by the Contractor or manufacturer producing materials for the Contractor. Acceptance testing will be at the expense of the Contractor.

1.11 QUALITY CONTROL TESTING:

A. The quality control testing is the testing of specific work product or materials during placement, as specified in the various sections of the specifications to ensure compliance with the Contract Documents. The Contractor shall assume full responsibility for control testing and give sufficient notice to the Engineer to permit him to witness the tests. The quality control testing shall be at the expense of the Contractor and shall be performed by a certified independent testing laboratory that has been approved by the Engineer.

B. The Contractor shall submit the name, address, and qualifications together with the scope of proposed services of the proposed testing firm or individual to the Engineer for approval at least thirty (30) days prior to the scheduled commencement of any work involving such testing. Should the Contractor desire to use more than one firm for control testing, the required information shall be submitted for each proposed firm as specified herein.

C. The Contractor shall be responsible for furnishing all accessories, tools necessary to prepare and preserve the test samples as prescribed and delivering them to the approved testing laboratory.

D. The Contractor shall perform all quality control testing and furnish all equipment, instruments, qualified personnel and facilities necessary to perform all tests required by the Contract. All tests performed, and test results for each day shall be recorded in a daily report. These records shall remain complete and available to the Engineer at all times during the performance of the Contract and for a three-year period thereafter. Test records shall indicate the reference test, nature and number of observations made, and the number and type of deficiencies found.

E. All Field Tests and frequencies for civil construction work shall be in accordance with Maryland Department of Transportation (MDOT), Method of Tests, Volume 1 (Field Procedure) unless otherwise directed by this Specification.

F. During the installation and testing phases of the work, a representative of the CQC Staff shall be present on site to oversee the and monitor the CQC Plan activities and verify installation and test activities are compliant with the requirements of this specification.

1.12 TEST REPORTS:

A. Within five days after completion of testing performed by or for the Contractor, submit five (5) copies of certified test results to the Engineer. Indicate test reports required to be submitted pursuant to Network analysis, if applicable and specified under Section 01300, Article 1.02, PROGRESS SCHEDULE. Identify test reports with the information specified for SAMPLES in SECTION 01300 Article 1.06 and additionally, the name and address of the organization performing the test, and the date of the tests.

B. The CQC Plan Manager shall submit on monthly basis, a record of all Control testing, Quality Assurance and Quality Control reports along with test results approved in the format described earlier under Article 1.02 F.1. This report shall be used to confirm and verify that the quantities in place for the completed work, for which the Contractor requests payment, have been adequately tested.

1. 13 CONTRACT MONITORING:

A. The CQC Plan shall provide a schedule of planned and periodic Contractor internal audits to monitor and verify compliance with all aspects of CQC Plan. Qualified personnel not having direct responsibilities in the areas audited shall perform the audits. The CQC Plan shall also provide schedule of audits to be conducted by the CQC Plan manager for the work performed by the subcontractors, manufacturers/suppliers. The Engineer shall review the audit findings and determine the follow up action, including re-audit of deficient areas, if necessary. Five copies of the audit reports and follow up action reports

shall be submitted to the Engineer no later than fifteen (15) days after the audit for review and approval.

B The Engineer has the right to monitor the methods and procedures used for production and/or QA/QC testing and shall be provided with access to all areas in which work for this Contract is being performed and at no additional cost to MTA. Furnish all reasonable means, including Shop Drawings, Working Drawings, test data, etc., to enable the Engineer to ascertain that materials and workmanship comply with the Contract specifications. The Engineer may perform periodic quality audits during the performance of the Contract. The Contractor shall take prompt corrective actions for items identified as not conforming to procedures approved under Contract terms.

1.14 CERTIFICATES OF COMPLIANCE:

A. The Contractor may use certificates of compliance for certain materials and products in lieu of the specified sampling and testing procedures. Submit any certificate required for demonstrating proof of compliance of materials with specification requirements in duplicate with each lot of material delivered to the work at least sixty days prior to the usage of the product/materials. The lot so certified shall be clearly identified by the certificate. Certificates shall be signed by an authorized representative of the producer or manufacturer and state that the material complies in all respects with the Contract requirements. The Network Analysis specified in Section 01300, Article 1.02, PROGRESS SCHEDULE, shall indicate the date scheduled for the submittal of certificates. In the case of multiple shipments, each of which is to be accompanied by a certificate of compliance, the scheduled date on the Network Analysis shall indicate the initial submittal only.

B. A certified copy of test results shall accompany the certificate of compliance. The certificate shall give the information specified for SAMPLES in Section 01300, Article 1.06 and in addition the name and address of the organization performing the tests, the date of the tests, and the quantity of the material shipped.

C. Materials used on the basis of a certificate of compliance may be sampled and tested at any time. The fact that material is used on the basis of a certificate of compliance shall not relieve the Contractor of responsibility for incorporating material in the work which conforms to the requirements of the Contract and any such material not conforming to such requirements will be subject to rejection, whether in place or not.

D. The Engineer reserves the right to refuse to permit the use of certain materials / supplies on the basis of a certificate of compliance.

1.15 SUBMITTALS:

A. The Contractor shall submit a Contract Quality Control Plan (CQC Plan) fully compliant with the requirements detailed under this Special Provision Section 01450 – Quality Assurance and Quality Control. Pursuant to the approval of the CQC Plan by the Engineer, the Contractor is responsible for fully implementing and maintaining the CQC Plan throughout the duration of the Contract.

B. Test Procedures for all tests identified in the CQC Plan.

C. Reports of factory and field inspections demonstrating compliance with the requirements specified in individual Special Provisions and Technical Provisions of the Contract Specifications.

D. Test schedules keyed to work activities planned under Contractors look ahead schedule.

PART 2: PRODUCTS

(NOT USED)

PART 3: EXECUTION

(NOT USED)

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT

A. Quality Assurance and Quality Control shall be measured by the Engineer. The bid price for Quality Assurance and Quality Control shall be divided by the total number of calendar days of Contract duration, as specified in Contract Special Provision Section 01000 – Summary of Work under "Completion Time and Liquidated Damages", to determine a daily rate for payment for successful performance. The Engineer, at his sole discretion, shall determine the Contractor's successful or unsuccessful performance with the requirements of the approved CQC Plan. The basis of unsuccessful performance shall be the issuance of a "CQC Plan Deficiency Notice" or a "Nonconformance Report" by the Engineer.

4.02 PAYMENT

A. Quality Assurance and Quality Control will be paid as an allowance on an earned daily basis for each day the Contractor successfully performs all requirements of the approved CQC Plan. The Contractor will earn payment, on a daily basis, based for successful performance of all

requirements of the approved CQC Plans. Payments will not be earned or made for any day that the Contractor fails to successfully perform the requirements of the approved CQC Plans.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROL

PART 1: GENERAL

1.01 DESCRIPTION:

This Section specifies the general requirements for furnishing, installing, and operating any temporary facilities and controls. This Section includes:

A. Temporary Utility Service

B. Temporary Sanitary Facilities

C. Project Identification

D. Protection of Existing Facilities

E. Orange Plastic Safety Fence and Snow Fencing

F. Work and Storage Areas

G. Community Relations

H. Construction Operations Under Traffic

I. Safety Requirements

J. Pollution Abatement

K. Historical and Scientific Specimens

L. Salvage Material and Equipment

1.02 TEMPORARY UTILITY SERVICE:

A. Determine the need for such temporary utility service as may be required to prosecute the work and make arrangements with utility companies for such service. Remove all materials and equipment involved with temporary utility service as part of final cleanup. All costs incurred in obtaining permits; utility service, including connection and disconnection; and furnishing, installing, maintaining, and removing such materials as may be required shall be borne by the Contractor.

1.03 TEMPORARY SANITARY FACILITIES:

A. The Contractor shall furnish for use of his work force the necessary toilet conveniences, secluded from public observation. Keep in a clean, sanitary condition. Comply with the requirements and regulations of the State of Maryland, Department of Health, and other agencies having jurisdiction.

1.04 PROJECT IDENTIFICATION:

A. Field Office Signs: provide one sign each for the Engineer's Field Office and the Contractors Field Office to indicate the location of the offices. Use ½ or ¾ inch thick exterior, A-B grade plywood, cut two (2) feet by four (4) feet long. Paint the sign with on coat of primer sealer and two coats of white semi-gloss enamel. Letter each sign with black enamel paint, using block letters at least four (4) inches high, with the Contract Name, Contract Number and the words ENGINEER's or CONTRACTOR'S FIELD OFFICE painted each on a separate line. Where the field office to be so identified is not readily visible from the project entrance, paint a directional arrow on the sign and locate the sign near the project entrance. The exact location of the field office signs and the proposed method of mounting shall be subject to the approval of the Engineer.

B. Contractor's Identification Signs: The Contractor may erect his own signs to identify himself and, if he wishes, his subcontractors. The overall size of the Contractor's identification signs shall not exceed four (4) feet by eight (8) feet wide. The exact location, method of mounting and mounting height of the Contractor's identification signs will be subject to the approval of the Engineer.

C. Sign Maintenance: Maintain all signs throughout the course of construction until final acceptance, keeping them clean, in good repair, and free of obstructions. Upon final acceptance of the work, remove and dispose of all signs.

D. All signs place shall be in compliance with local signage requirements. This shall include permits and approvals of local governing bodies as prescribe by law or statute.

1.05 MAINTENANCE AND CONTROL OF TRAFFIC:

A. The Contractor shall furnish, install, maintain, and remove when no longer require, all traffic control (which includes vehicle and pedestrian above/below ground and in and around stations and Administrations facilities where the Contractor is performing work) and protective devices required on the approved traffic plan. Traffic control and protective devices shall include temporary directional electrical warning signs, detour signs, temporary barricades and guard rails; temporary lighting, overhead

warning lights, and flashing lights; removal of permanent and temporary pavement markings; and the services of qualified flagmen. The Contractor shall maintain constant communications with the local jurisdictional agency regarding his operations in maintaining and controlling traffic.

1. Traffic Control Signs: Each change in location of traffic shall be adequately posted with signs mounted on barricades or standard posts. All regulatory signs required for the construction areas will be provided and removed by the appropriate jurisdictional agency.

2. Pavement Marking: The Contractor shall install necessary temporary pavement marking required in connection with the temporary street work and shall remove or obliterate existing or temporary pavement markings whenever vehicle traffic is moved to a newly available pavement area or to different traffic patterns. Permanent paving markings for public streets will be provided by the local jurisdictional agency, unless otherwise indicated.

3. Redirecting Traffic: All channelizing, shifting of traffic lanes, and barricading of traffic in connection with the work will be subject to approval of the appropriate jurisdictional agency. Existing local standards for signing and marking of construction will apply in addition to ANSI D6.1e, Manual of Uniform Traffic Control Devices. All lanes intended for traffic use shall be kept clear for width of eleven (11) feet except that ten (10) feet may be used provided all vertical obstructions are kept four or more feet from the edge of the lane.

4. Contractor Surface Operations: The Contractor shall schedule his surface operations to not be working intermittently throughout the area. Excavation or construction activities shall be scheduled and pursued to completion as required to permit opening of the street areas to traffic without unnecessary delays.

5. Temporary Walkways: In areas where removal of existing sidewalks is necessary, access to adjacent businesses, entrances and properties shall be maintained by temporary walkways having a width of not less than six feet.

6. Temporary Paving and Patching: The Contractor shall construct, maintain and remove temporary pavement and patching required to safely and expeditiously handle vehicle and pedestrian traffic, within or adjacent to the construction site. Temporary pavement and patching composition shall conform to the specifications of the local jurisdictional agency. Any construction, maintenance or removal required by the Contractor’s operations off the site shall conform to the requirements specified herein.

1.06 WORK AND STORAGE AREAS:

A. The Administration is not providing work areas or parking for the Contractor. Work and storage space, if required, shall be provided by the Contractor at his own expense. Parking facilities for the Contractor's personnel shall be the Contractor's responsibility.

1.07 SAFETY REQUIREMENTS:

A. Refer to the General Provisions Sections GP-7 Legal Relations and Responsibility to Public , the General Provision's Articles GP-7.05 Construction Safety and Health Standards , GP-7.06 Public Convenience and Safety , Supplementary General Provision SGP-7.10 Contractor's Safety Program: and MTA Project OCIP Safety Guidlines

B. Employ and assign to the work a full-time Safety Superintendent who has the specialized training and experience in construction safety supervision, is thoroughly familiar with OSHA requirements, and is acceptable to the Engineer. Employ the Safety Superintendent exclusively for purpose of supervising the safety of persons on or about the work and property affected thereby.

C. First Aid Stations: At sites of the work, establish and fully equip a first aid station. Maintain a qualified first aid attendant on duty in the station at all times when the work is in progress, except when on emergency calls.

1.10 POLLUTION ABATEMENT:

A. General: Refer to General Provisions Section GP-7. Conduct operations in a manner to minimize pollution of the environment surrounding the area of work by every means possible. Apply specific controls as follows:

1. Material Transport: Truck leaving the site and entering paved public streets shall be cleaned of mud and dirt clinging to body and wheels of the vehicle. Trucks arriving at and leaving the site with materials shall be loaded in a manner and covered which will prevent dropping of materials or debris on the streets. Contractor shall maintain a suitable vehicle cleaning and inspection installation with permanent crew for this purpose. Spills of materials in public areas shall be removed immediately at no additional cost to the Administration.

2. Waste Materials: No waste or erosion materials shall be allowed to enter natural or man-made water or sewage removal systems. Erosion materials from excavations, borrow areas or stockpiled fill shall be contained within the work area. Contractor shall develop

methods for control of waste and erosion which shall include such means as filtration, settlement and manual removal.

3. Burning: No burning of waste or other materials will be allowed.

4. Dust Control: the Contractor shall at all times control the generation of dust by his operations. Control of dust is mandatory and shall be accomplished by water sprinkling or by other methods approved by the Engineer.

5. Noise Control:

   a. General: Minimize noise caused by work operations, and provide working machinery and equipment fitted with efficient noise suppression devices. Employ other noise abatement measures necessary for protection of both employees and the public. In addition, restrict working hours and schedule operations in a manner that will minimize to the greatest extent feasible, disturbance to residents in the vicinity of the work. Provide protection against noise exposure for employees in accordance with GP 7.05.

   b. Definitions:

      i. Daytime refers to the period from 7:00 a.m. to 10:00 p.m. local time daily except Sundays and legal holidays. Nighttime, refers to all other times including all day Sunday and legal holidays.

      ii. Construction Limits are defined for the purpose of these noise control requirements as the Administrations right-of-way lines or property lines as indicated on the drawings.

      iii. Zones, Special Zones and special Construction sites outside of Construction Limits shall be designated by the local agency having jurisdiction.

   c. Monitoring: Monitor noise levels of work operations to assure compliance with the noise limitations contained herein. Retain record of noise measurements for inspection by the Engineer. Promptly inform the Engineer of any complaints received from the public regarding noise. Describe the action proposed and the schedule for implementation and subsequently inform the Engineer of the results of the action.

d. Measurement Procedure:

i. Except where otherwise indicated, perform all noise measurements using the A-weight network and (slow) response of an instrument complying with the criteria for Type 2 General Purpose sound level meter as described in ANSI S1.4. Measure impulsive or impact noises with an impulse sound level meter complying with the criteria of IEC 179 for impulse sound level meters. As an alternative procedure, a type 2 General Purpose sound level meter on C-weighting and (fast) response may be used to estimate peak values of impulsive or impact noises. Transient meter indications of 125 dbC (fast) or higher will be considered as indications of impulsive noise levels of 140 db or greater.

ii. Measure noise level at buildings affected acoustically by the Contractor's operations at points between three feet and six feet from the building face to minimize the effect of reflections.

iii. Measure noise levels at points on the outer boundaries of Construction Limits or Special Construction Sites for noise emanating from within.

iv. Where more than one set of criteria for noise limits are applicable, use the more restrictive requirement for determining compliance.

e. Noise Restrictions:

i. Noise Restrictions, General: Prevent noise emanating from within Construction Limits or Special Construction Sites, measured at the boundary, from exceeding a peak impulse of impact noise level of 140 db, as measured with a standard impulse sound level meter (or alternatively) 125 dbC fast as measured on a type 2 General Purpose sound level meter or a noise level of 90 dbA slow as measured on a type 2 General Purpose sound level meter. When conditions require that demolition or construction activities be located less than 50 feet from the construction limits or boundary of a Special Construction Site, the noise level may exceed 90 dbA by the amounts shown in Table 1, except do not

exceed the noise levels at the affected structure specified in Article 1.10.A.5.e.(2) below.

TABLE 1	
Distance of Source From Boundary, ft.	Permissible Excess
0 - 5	20
6 - 10	14
11 - 20	8
21 - 30	5
31 - 40	2
41 - 50	0

ii. Noise Restrictions at Affected Structures: Prevent noise levels at the affected structure from exceeding those specified in Tables 2 and 3.

iii. Stationary Noise Sources, Outside Construction Limits: In areas outside of Construction Limits and not designated as a Special Construction Site or Special Zone by the local agency having jurisdiction, prevent noise from stationary sources, parked mobile sources or any source or combination of sources producing repetitively scheduled or long-term noise lasting more than a few hours from exceeding the limits specified in Table 2.

iv. Intermittent Noise Sources, Outside Construction Limits: Prevent noises from nonstationary mobile equipment operated by a driver or from any source of nonscheduled, intermittent, non-repetitive, short-term noises not lasting more than a few hours, but not including trucks on public thoroughfares, from exceeding the limits specified in Table 3.

v. Special Construction Sites: In areas outside of Construction Limits but for which the Contractor has obtained designation as a Special Construction Site from the local agency having jurisdiction, prevent noise levels from exceeding those specified in Tables 2 and 3 for buildings in industrial areas.

vi. Special Zones: In zones designated by the local agency having jurisdiction as a special zone, such as a hospital zones, the noise level and working time restrictions imposed by the agency shall apply. These zones and work hour restrictions shall be obtained by the Contractor from the local agency. No additional compensation will be allowed due to more severe noise level or work hour restrictions than those specified herein.

TABLE 2: CONTINUOUS NOISE		
Affected Structure	Maximum Allowable Continuous Noise Level, dbA	
	Daytime	Nighttime
Residential		
In quiet residential areas	60	50
On arterial or in multifamily residential / commercial areas	65	55
In semi-residential / commercial areas	70	60
Commercial		
in semi-residential / commercial areas	70	70
in commercial areas with no nighttime residency	75	75
Industrial		
all locations	80	80

TABLE 3: INTERMITTENT NOISE		
Affected Structure	Maximum Allowable Continuous Noise Level, dbA	
	Daytime	Nighttime
Residential		
In quiet residential areas	75	60
On arterial or in multifamily residential / commercial areas	80	65
In semi-residential / commercial areas	85	70
Commercial		
in semi-residential / commercial areas	85	85
in commercial areas with no nighttime residency	85	85
Industrial		
all locations	90	90

f. Equipment Noise Emission Restrictions: Use only equipment which will meet the noise limits specified in Table 4, when measured fifty feet from the equipment in substantial conformity with the provisions of SAE J366a and SAE J952b and in accordance with the measurement procedures specified herein.

TABLE 4: EQUIPMENT NOISE EMISSION RESTRICTIONS		
Type of Equipment	Maximum Allowable Continuous Noise Level, dbA	
	Before Jan. 1, 1977	After Jan 1, 1977
Residential		
All equipment other than highway trucks; including hand tools and heavy equipment, except pile drivers	90 dbA	85 dbA
Highway trucks in any operating mode or location	88 dbA	83 dbA

g. Noise Abatement Measures: Utilize the noise abatement measures listed below to minimize to the greatest extent feasible, the noise levels in all areas outside of the construction limits.

i. Utilize shields, impervious fences or other physical sound barriers to inhibit transmission of noise.

ii. Utilize sound retardant housing or enclosures around noise producing equipment.

iii. Utilize effective intake and exhaust mufflers on internal combustion engines and compressors.

iv. Line or cover hoppers, storage bins and chutes with sound deadening material.

v. Minimize the use of gasoline driven saws.

vi. Conduct truck loading, unloading and hauling operation so that noise is kept to a minimum.

vii. Route construction equipment and vehicles carrying spoils, concrete or other materials over streets that will cause the least disturbance to residents in the vicinity of the work. Advise the Engineer in writing of the proposed haul routes prior to securing a permit from the local government.

viii. Site stationary equipment to minimize noise impact on the community, subject to the approval of the Engineer.

ix. Wherever feasible, use vibratory pile driver or augering for setting piles in lieu of impact pile drivers. If impact pile drivers must be used, their use shall be restricted to 8:00 a.m. to 5:00 p.m. weekdays.

B. Maintaining Flow of Sewers and Drains: The Contractor shall, at his own expense, provide for and maintain the flow of all sewers, drains, house or inlet connections, and all water courses which may be met during progress of the work. The Contractor shall not allow the contents of any sewer, drain, or house or inlet connection to flow into trenches. The Contractor shall, at his own expense, immediately remove from proximity of the work all offensive matter, using such precautions as are required by the Engineer.

1.11 HISTORICAL AND SCIENTIFIC SPECIMENS:

A. All articles of historical or scientific value, including coins, fossils, and articles of antiquity, which may be uncovered by Contractor during progress of the work, shall become the property of the Administration. Such findings shall be reported immediately to the Engineer who will determine method of removal, where necessary, and final disposition thereof.

1.12 SALVAGE MATERIALS AND EQUIPMENT:

A. The Contractor shall maintain adequate property control records for materials and equipment specified to be salvaged. Contractor shall be responsible for the adequate storage and protection of salvaged materials and equipment. The Contractor shall replace, at no cost to the Administration, salvage materials and equipment which are broken or damaged during the salvage operations as the result of the Contractor's negligence.

B. Salvage material not specified for reuse shall be the property of the Contractor and shall be removed from the site. Once all information has been extracted and safeguarded and the storage media has been cleaned.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 TEMPORARY FACILITIES AND CONTROLS:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 01523

ENGINEER'S FIELD OFFICE

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work specified in this Section includes supporting an existing engineer's field trailer located at 4200 Old Court Road, Pikesville, Maryland 21208.

1.02 RELATED WORK:

A. The General Provisions of the contract, including General and Supplementary Conditions and Division 1 Specifications, apply to this section.

PART 2: PRODUCTS

NOT APPLICABLE

ENGINEER'S FIELD OFFICE TYPE 3

PART 3: EXECUTION

3.01 ENGINEER'S FIELD OFFICE SUPPORT:

A. All services provided shall be directed in writing by the Engineer with specific reference to this specification section.

B. Possible services to be provided may include any of the following:

1. Cleaning services and/or cleaning supplies for the existing trailer.

2. Office supplies.

3. Copy machine services or payment of bills for existing service.

4. Payment of utility bills directly associated with the existing trailer which may include telephone service, electricity, bottled water, and waste garbage disposal.

5. Repairs and maintenance of the existing trailer.

6. Property maintenace for the ground on which the existing trailer is located.

7. Minor improvements to the existing trailer and surrounding property.

8. Provision of additional furniture and appurtances for the trailer or the surrounding property.

C. All bills for utilities and regular provision of services shall be paid promptly and within the due date stated on the invoice. Any costs incurred by the Engineer as a result of late payment of invoices shall be borne by the Contractor.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. The amounts to be paid for all items associated with the payment of invoices will be calculated in accordance with the requirements of Article SGP 4.03A with the associated mark-up for materials in accordance with Article SGP 4.03E. All costs will be paid from the allowance under "Engineer's Field Office."

B. When the installed and accepted work is performed and agreed upon in writing pursuant to the direct cost adjustment requirements of Article SGP – 4.03 with the exception of paragraph G & J, such work shall be paid from the allowance under "Engineer's Field Office."

C. When the installed and accepted work is performed and agreed upon in writing pursuant to the requirements of Article SGP – 9.02, such work shall be paid from the allowance under "Engineer's Field Office."

D. The payment for additional work/changes under "Engineer's Field Office" includes any and all costs associated with the assigned work.

END OF SECTION

SECTION 01562

TEMPORARY CONSTRUCTION FENCE

PART 1: GENERAL

1.01 DESCRIPTION:

This item of work consists of furnishing, installing, maintaining, resetting and when directed by the Engineering removing Temporary Construction Fence at locations indicated on the Plans and/or where directed by the Engineer. Note: This fence is not a safety barrier.

PART 2: PRODUCTS

2.01 MATERIALS:

A. Precast Concrete Blocks shall be solid concrete masonry block C 139.

B. Tie Wire, Tension Wires, Tension Wire Clips and Hardware. The galvanized coating shall have a minimum weight of 1.2 oz/ft2. When used with aluminum coated steel fabric; these items shall be coated with aluminum at a minimum weight of 0.40 oz/ft2. The tension wire used with polyvinyl chloride (PVC) coated steel fabric shall have the same coating thickness and color requirements as the fence fabric.

C. Orange Mesh Fencing shall be four foot high 160 lb tensile strength durable heavy duty mesh, and UV stabilized polyethylene with smooth bottom and top edges.

D. Fence posts shall be four foot high, 1.90 in. diameter round posts; or 5-1/2 ft high, 2 in. steel U channel posts, as specified herein.

E. Submit samples of the fence fabric, fence posts, movable precast concrete blocks, tie wire, tension wires, and other miscellaneous hardware for approval.

F. Note: Any and all materials deemed by the Engineer unsuitable for resetting shall be replaced by the Contractor at his expense.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS:

A. Temporary construction fence shall be at least 4 ft high and with a maximum post spacing of 8 ft. When installed on a paved surface, support the fence by inserting the round post into a precast concrete block having a round hole through the center of the block. When installed in unpaved areas, use steel U channel fence posts driven 1-1/2 ft into the ground. Installation of the fence in any other manner will require approval.

B. Secure the fabric to the posts by wrapping a tie wire around the horizontal fence strands and the posts. Install a top tension wire to prevent sagging. When installed on paved surfaces, the Engineer will determine if a bottom tension wire is required. Remove the fence when the Engineer determines that the fence is no longer required. The removed fence is the property of the Contractor.

C. Damaged Construction Fence. Repair or replace damaged construction fence within four hours after notification.

D. Temporary orange construction fencing shall be utilized, unless otherwise indicated.

E. Temporary green construction fencing shall be utilized at Penn Line sites.

PART 4: MEASUREMENT AND PAYMENT

4.01 TEMPORARY CONSTRUCTION FENCE:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 01570

ENVIRONMENTAL PROTECTION

PART 1: GENERAL

1.01 DESCRIPTION:

A. Refer to General Provisions Section GP-7. This section specifies the requirements for environmental protection and stewardship that pertain to, but are not limited to the following environmental topics:

1. Waste Handling
2. Stormwater Management
3. Sanitary Sewer Discharge
4. Air Quality Management, See SECTION 01505 Temporary Facilities
5. Construction Materials and Storage
6. Spill Prevention and Management
7. Special Hazardous Materials
8. Equipment Decommissioning
9. Contaminated Soils and Groundwater
10. Underground Storage Tanks (UST)
11. Natural Resources
12. Wetland Rectification
13. Historical, Archeological, and Cultural Resources

C. The Maryland Transit Administration (MTA) operates in accordance with guidance set forth in their Environmental Policy and an Environmental Management System (EMS) that meets the International Organization for Standardization's (ISO) standard for Environmental Management Systems (ISO 14001). The MTA's EMS prevents adverse environmental impacts by instituting a structured approach to environmental protection and stewardship in daily operations, including those of MTA's contractors and suppliers.

D. The following information is supplied to contractors and suppliers who perform work for the MTA and is intended to make them aware of the EMS and to ensure conformance to the MTA's Environmental Policy and applicable EMS procedures and instructions. Conformance with the

Environmental Policy and all requirements noted in this document is expected of all those persons working for or on behalf of the MTA which includes contractors, subcontractors, suppliers and their employees at a job site.

E. Failure to follow these requirements can result in penalties or work stoppage which will be determined and controlled by the MTA Construction Resident Engineer.

F. Contact the MTA Environmental Manager through the Resident Engineer with any questions regarding the Environmental Policy and/or any other environmental related documents.

1.02 GENERAL REQUIREMENTS

A. General Requirement - MTA contractors, subcontractors, suppliers and their employees will minimize environmental pollution and damage that may occur as the result of construction operations. The environmental resources within the project boundaries and those affected outside the limits of permanent work must be protected during the entire duration of this contract. Any delays resulting from failure to comply with environmental laws and regulations will be the Contractor's responsibility.

B. Pollution Prevention - Contractors/suppliers are responsible for preventing pollution of the air, water and land, and for the proper disposition of waste generated by their activities. The following guidelines provide specific information to assist contractors/suppliers with this requirement, but these guidelines do not take the place of federal, state and local regulations. The contractor / supplier must comply with all federal, state, and local regulations.

C. Environmental Regulation Compliance - In addition to preventing pollution, contractors/suppliers are responsible for their own compliance with all applicable federal, state and local environmental regulations pertaining to environmental protection.

D. Excavation Control - Contractors / Suppliers will need to complete the Contractor Environmental Checklist (See section 1.03) to ensure no environmental risk is posed by excavation activities. Excavation may require permits from the Maryland Department of the Environment (MDE).

E. Community Awareness - Contractors / Suppliers will be sensitive to the effects of noise, odor, light, and traffic movement to the local community.

F. Good Housekeeping - Contractors / Suppliers are responsible for keeping the site clean and orderly. Site cleanliness should be evaluated daily and all trash and debris should be properly disposed of by the close-of-business each day.

G. Training – Contractors / Suppliers employees shall be trained on applicable federal, state, and local environmental regulations and standards. Contractors / Suppliers will provide copies of employee training certificates per the contract requirements or upon request from the MTA Environmental Manager or Site Resident Engineer. All documents will be submitted to the Resident Engineer for processing.

H. Compliance by subcontractors with the provisions of this and various other sections of these specifications is the responsibility of the Contractor.

I. Use of equipment from which factory-installed antipollution and noise control devices are removed or rendered ineffective, either intentionally or through lack of proper maintenance is prohibited.

1.03 SUBMITTALS

A. Submit the following for approval with additional requirements as specified by each.

1. Contractor Environmental Checklist (CDRL) – The contractor will submit the "Environmental Checklist" no more than 15 days after the issuance of the NTP. No field work will commence before the checklist has been completed and approved. The purpose of this form is to establish whether or not a particular activity poses a substantial environmental risk that needs specific additional controls. The MTA Environmental Manager will review this checklist and determine whether or not the proposed project activities pose a substantial environmental risk. If the expected environmental risk needs no further controls, the MTA Environmental Manager will approve the checklist noting that "no further action" is needed and the checklist will be returned to the MTA Resident Engineer no later than 14 days after receipt. If the MTA Environmental Manager determines that additional controls are needed, the "Contractor Environmental Activity Statement" will be required. This form will be provided to the Contractor and will be returned to the Environmental Manager. The Environmental Manager will coordinate subsequent activity with the MTA Resident Engineer.

2. Contractor Environmental Activity Statement (CDRL) - This form is used when the MTA Environmental Manager determines that a contractor/supplier's activities pose a substantial risk of an adverse environmental impact such that additional controls are needed. Upon request, contractors are to submit a written statement outlining their activities and procedures for minimizing and managing the actual or potential environmental impacts of their operations using the Contractor Environmental Activity Statement form provided. The Activity Statement must address potential risks to the environment, contractors, employees and other personnel associated with MTA project activities and proposed measures for minimizing these risks. This form will only be required of the successful bidder and will be completed no more than 10 days after the "Environmental Checklist" has been submitted. Upon approval by the MTA Environmental Manager in coordination with the Resident Engineer, the contractor/supplier may commence work on the site.

1.04 WASTE HANDLING

A. Proper Waste Handling is Contractor Responsibility - All waste disposal (i.e., construction debris, scrap metal, municipal solid waste, non-hazardous waste, hazardous waste, etc.) will be the responsibility of the contractor. Labeling, storage and disposal of all waste material must follow all applicable Federal and State regulations. Do not dump debris or rubbish of any kind into or allow to deposit into a waterway, onto adjacent banks, or onto roadways. All waste disposal routes will be approved by the EM through the Resident Engineer. Hazardous waste manifests will only be approved and signed by members of the MTA Environmental group.

B. Pick up trash and place in containers. Trash containers will be emptied on a regular schedule. Conduct handling and disposal to prevent contamination of the site and other areas. Do not dispose of in wetlands or burn waste materials on the site. Upon project completion, site should be restored to a clean and neat appearance.

C. Transport all waste off the site to an approved disposal site and dispose of it in a manner that complies with Federal, State, and local requirements. Approval of the disposal site is required by the Resident Engineer along with the MTA Environmental Manager depending on the waste type.

D. Waste haulers must obtain a permit or license prior to transporting any material off the site. The Contractor shall provide and maintain containers and dumpsters or haul away material to be disposed of. The Contractor shall not use adjacent business's dumpsters.

E. Hazardous Waste Notification - The contractor must notify the MTA Environmental Manager through the MTA Resident Engineer of all hazardous waste streams to be generated before a waste is generated and collected on site. The MTA Environmental Manager will approve the storage location of all generated hazardous waste, maximum quantities and the container type(s) used. The hazardous waste manifest will be approved by the MTA Environmental Manager. Site Hazardous Waste ID numbers will be coordinated with the MTA Environmental Manager.
Hazardous waste manifests will be signed by the Environmental group of the OSQARM. Copies of hazardous waste manifests will be provided through the Resident Engineer to the Environmental Manager.

F. Waste Container Labeling - Containers (such as drums) must be labeled with the contents of the drum (or other container) and the responsible contractor's name and contact information. NO UNLABELED CONTAINERS ARE PERMITTED ON SITE.

G. Waste Documentation - Shipping information and paperwork (MSDS, Waste Profiles, Bills of Lading, Manifests and inventory) must be provided upon request to MTA.

H. Waste from demolition or other work at MTA that is deemed recyclable must be properly managed and conveyed to an approved facility. Recycled material totals and manifest/weigh bills must be provided to the Environmental Manager through the Resident Engineer.

1.05 STORMWATER MANAGEMENT

A. Erosion and Sedimentation Permit – Contractor must obtain a permit for any land disturbance activities that disturbs 5,000 square feet or more of land or results in 100 cubic yards or more of earth movement, if not included in the bid package.

B. An Erosion and Sedimentation Control Plan and Storm Water Management Plan may also be required in the contract documents. Stormwater management on MTA sites must adhere to all pertinent Federal, State, and local regulations. The most stringent local requirement should be followed.

C. Storm Water Control Measures Required – If not already included in the bid package, it is the contractor's responsibility to install storm water control measures such as silt fences, straw bales, etc. to control the solids entering storm drains from erosion or other processes, if necessary. This requirement will also appear in the contract document as required and is not intended to be a duplication of effort.

D. No Solids into Storm Drains - Solids must be prevented from entering storm drains. Roadways and outside areas must be kept clean. Compliance with the CLEAN WATER ACT is mandatory.

E. No Co-Mingling of Process Materials - No process materials or any other sources of water pollutant shall be co-mingled with storm water.

F. Cover Dirt Piles - All dirt piles must be covered to prevent solids from entering storm drains unless otherwise directed. Covering must conform to MDE requirements.

G. Prevent Vehicle Fluids from Entering Storm Water - Vehicle maintenance shall not be performed near storm drains unless provisions have been made to contain any spills of vehicle fluids, including oil, gasoline and antifreeze.

H. Inspections required by the stormwater permit must be completed and a copy forwarded through the Resident Engineer to the Environmental Manager.

1.05 SANITARY SEWER DISCHARGE

A. No Discharge to Sanitary Sewers without Approval - Discharge of material other than sanitary sewage to ANY sanitary sewer system is prohibited without the prior consent of the MTA Environmental Manager. Handling of material discharge will be discussed and agreed in the Contractor Activity Statement prior to the NTP.

1.06 AIR QUALITY MANAGEMENT

A. Dust Control - Contractors will provide adequate control of fugitive dust emissions during all operations and activities. Refer to Section 01500.

B. Other Emissions - Contractors/Suppliers must comply with all Clean Air Act requirements for emissions from their activities. Other emissions such as purposeful venting of CFC-containing refrigerants are strictly prohibited.

C. Noise – Contractor will provide adequate noise control and monitoring devices. Refer to Section 01500 of the contract document.

1.07 CONSTRUCTION MATERIALS AND STORAGE

A. MSDS Knowledge Requirement - Contractors will not transport hazardous chemicals onto the project site without having prior approval of the

associated Material Safety Data Sheets (MSDS), from the MTA Office of Safety, Quality Assurance and Risk Management. These materials may include, but are not limited to, sealers, adhesives, paints, coatings, fuels, oils, acids and caustics. All sizes of containers require review and approval before their use on site prior to NTP.

B. MSDS Availability Requirement - The contractor will have available the Material Safety Data Sheets (MSDS) for all chemical products in use at all times that their employees are working with on site. MSDS's will be made available upon request.

C. MTA Consent Required for Material Storage - There will be no storage of any materials and supplies on MTA property without the consent of the MTA Resident Engineer. Areas for material storage will be selected and safeguards put in place to prevent stormwater runoff contamination.

D. Secondary Containment Requirement - Approved outside storage areas for chemical materials must be equipped with non-earthen secondary containment equal to 110% of the capacity of the largest container by the contractor.

E. Container Type and Labeling Requirement - The contractor will ensure that all material containers owned or managed by the contractor are compatible with the material stored in the container and will be properly labeled in accordance with the OSHA HAZARD COMMUNICATION STANDARD and DOT standards (i.e., contents, primary hazard).

F. Keep Chemical Containers Closed - The contractor will ensure that chemical containers are closed except when in use.

G. Spill Kit Requirement - Contractors will maintain spill kits to contain and clean up small spills generated by their employees or from their materials. Spill kits will be kept on site and will be easily accessible during an emergency. Spill kits will be approved by the Resident Engineer.

1.08 SPILL PREVENTION AND MANAGEMENT

A. Prevention - Contractors will provide adequate spill/release prevention (such as secondary containment) for all bulk materials. Conduct fueling and lubricating of equipment and motor vehicles onsite in a manner that prevents spills and evaporation. Dispose of lubricants in accordance with approved procedures meeting state, and local regulations. For oil and hazardous material spills that violate state, and local regulations, notify immediately the Resident Engineer.

B. Spill Response - THE CONTRACTOR WILL IMMEDIATELY REPORT ALL SPILLS OR RELEASES OF MATERIALS to the MTA Resident Engineer who will in turn notify the ENVIRONMENTAL MANAGER. Contractors will complete spill mitigation and document the clean up with field notes and photos, until the spill incident is deemed closed by the MTA Environmental Manager.

1.09 SPECIAL HAZARD MATERIALS

A. Polychlorinated Biphenyls (PCB): (Immediately report any PCB chemical substance, mixture, equipment, container, sealant, coating or dust control agent, found stored within the project area to the Resident Engineer in writing and stop work in the area.)

1. Suspected PCB Notification - If a material is suspected to have PCB contamination, the MTA Environmental Manager is to be notified via the Resident Engineer. Contractors/suppliers must manage materials and waste that contains PCB in accordance with the Toxic Substances Control Act (TSCA). Do not use PCB chemical substance, mixture, equipment, container, sealant, coating, or dust control agent except in accordance with all provisions of the Maryland Department of Health and Mental Hygiene as interpreted by the rules and regulations of 40 CFR 761.

2. MTA Environmental Manager Coordinates PCB Removal - All PCB removal conducted by the contractor/supplier shall be coordinated with the MTA Environmental Manager through the MTA Resident Engineer.

3. Lighting Ballast Disposal - Any lighting ballast that does not state that it is a non-PCB containing ballast must be disposed of as recycled PCB containing ballast.

B. Asbestos Containing Material (ACM)

1. Notification Requirement – Prior to initiating any field work, the contractor will evaluate all demolition and renovation work for the presence of ACM and ensure that this assessment is conducted by a Qualified Person (QP). A QP as defined in 29 CFR 1926.32(f), is a person capable of identifying existing asbestos hazards in the workplace and selecting the appropriate control strategy for asbestos exposure and has the authority to take prompt corrective measures to eliminate them. If the contractor identifies ACM during preliminary evaluation of work, they must inform the Resident Engineer who will contact the MTA Environmental Manager.

2. MTA Asbestos Management Procedure - All asbestos removal and disposal activities will be conducted in accordance with procedures approved by the MTA Environmental Manager. Approval for asbestos work will be prior to NTP for Ancillary Contract work and prior to initiating field work on Bid Contracts. In the event the Contractor, during the course of the work on the project, encounters the presence of asbestos or any ACM, PCBs or any other hazardous materials as recognized by the Maryland State Department of Health and Mental Hygiene, promptly notify the Resident Engineer, and BGE/CPSGI if located on their property. Do not perform any work pertinent to the asbestos or hazardous material prior to receipt of special instructions from the Administration through the Engineer. Any delay in the progress of the work as a result of encountering either asbestos or hazardous materials on the project will be mitigated by the Administration. Within 24 hours of this notification to the Administration through the Resident Engineer of the encountering asbestos or hazardous materials, the Contractor will meet with the Resident Engineer to re-plan and work around the affected area. The Administration will provide the special instructions without delay and with the approval of the MTA Environmental Manager, authorizing work to progress.

3. Compliance with Regulations - Contractors/suppliers engaged in activities that involve ACM shall comply with 29 CFR 1926.1101, 29 CFR 1910.1001 (and related Maryland regulations) as regulated by the Maryland Department of the Environment (MDE).

C. Lead

1. Lead Testing Requirement - Contractors are responsible for testing for the presence of lead based paints when working or welding on building or building structural steel. Testing will be done by an approved lab as directed by the MTA Environmental Manager. This testing will be conducted prior to work and coordinated through the MTA Resident Engineer. Test results and chain of custodies will be supplied to MTA.

2. MTA Lead Management Procedure - All lead removal and disposal activities will be conducted in accordance with procedures approved by the MTA Environmental Manager and the applicable OSHA Lead Standard for the specific project activities.

3. Compliance with Regulations - Contractors/suppliers engaged in activities that involve lead shall comply with 29 CFR 1910.25 (the

general industry lead standard) and, for construction activities 29 CFR 1926.62 (in conformance with the requirements of the Maryland Occupation Safety and Health).

D. Refrigerants (CFCs)

1. Training Requirement - Contractors will provide copies of employee training certificates to the Resident Engineer for transmittal to the MTA Environmental Manager upon request.

2. No CFC Venting - Intentional venting of CFCs to the atmosphere is strictly prohibited. Records of recycling shall be maintained for removed CFC's and provided to MTA Environmental group through the Resident Engineer.

1.10 EQUIPMENT DECOMMISSIONING

A. Inspection Requirement - All equipment will be thoroughly inspected by the contractor for fluids and other hazardous materials prior to removal.

B. Fluids and Hazardous Material Management Requirement - All fluids and other hazardous materials in the equipment will be removed prior to decommissioning and disposal of any waste generated will be handled in accordance with local, State and Federal regulations.

1.11 CONTAMINATED SOILS AND GROUNDWATER

A. If the contractor encounters contaminated soils or groundwater during site excavations, the contractor must stop excavation and notify the Resident Engineer. The Resident Engineer will notify the Environmental Manager. The MTA will notify all pertinent regulatory agencies.

B. No contaminated soil or groundwater will be removed from the site until the contractor has had the material sampled, analyzed, and characterized by an approved testing laboratory. The Environmental Manager, through the Resident Engineer, will provide the contractor with a list of approved laboratories. Following characterization, the contractor will submit the results to the Environmental Manager through the Resident Engineer. Based upon the test results, the Environmental Manager will determine a suitable and approved disposal facility for the material. It is the contractor's responsibility to arrange for transport of the contaminated soil to the facility and submission of waste manifests to the Environmental Manager through the Resident Engineer.

C. The contractor will coordinate with the Resident Engineer and Environmental Manager to stockpile the material on site prior to disposal. The stockpile will be prepared to mitigate contamination to groundwater, loss off-site, or to any storm drains.

D. Contaminated material contains one or more contaminants from an unintentional or intentional spilling, leaking, pumping, pouring, emitting, emptying, or dumping of a hazardous substance, hazardous waste, pollutant, or naturally occurring contaminant at a concentration which fails to satisfy any applicable remediation standard.

E. Soils are considered hazardous and thus contaminated when the following criteria are met and must be managed according to applicable regulations:

1. Soils test positive for characteristics of a hazardous waste defined at Title 40 CFR Part 261 Subpart C 261.21-261.24.

2. Soil contains a listed waste as per 40 CFR 261 Subpart D 261.31-261.33.

3. Soil is a mixture of a solid waste (non-hazardous) and one or more hazardous wastes listed in 40 CFR 261 Subpart D 261.31-261.33.

4. Soil and Groundwater that have constituents that exceed the Maryland Residential and /or Non-residential reuse standards are considered contaminated. These standards are provided in the latest edition of the Maryland Department of Environment's Cleanup Standards for Soil and Groundwater. These contaminated soils and groundwater will be disposed of with the coordination and approval of the MTA's Environmental Manager in cooperation with the Resident Engineer.

1.12 UNDERGROUND STORAGE TANKS

A. If the contractor encounters an underground storage tank (UST) during site excavations, the contractor must stop excavation and notify the Resident Engineer. The Resident Engineer will notify the Environmental Manager. The MTA will notify all pertinent regulatory agencies.

1.13 NATURAL RESOURCES (AIR, WATER, AND LAND)

A. General: It is intended that the natural resources within the project boundaries and outside the limits of permanent work performed be preserved in their existing condition or be restored to an equivalent of the

existing condition, as approved by the Engineer upon completion of the work.

B. Land Resources:

1. Except in areas indicated to be cleared, do not remove, cut, deface, injure, or destroy trees, shrubs, and vegetation without special permission from the Engineer. Do not fasten or attach ropes, cables, or guys to any existing nearby trees for anchorage.

2. The use of herbicides is not permitted unless otherwise specified.

3. If not already included in the bid documents, submit a plan for protecting existing trees and vegetation to remain and that could be injured, bruised, defaced, and otherwise damaged by construction operations.

4. The contractor needs to adhere to State and Local tree/forest protection and mitigation measures, whichever is more stringent. At a minimum, the contractor must abide by the MD Reforestation Law and the Roadside Tree Law.

5. Repair and restoration: All trees and other landscape features scarred or damaged by the Contractors equipment and operations shall be repaired and restored to their original condition. Submit for the Engineer approval the repair and restoration plan prior to its execution. The repair and restoration plan shall be prepared in accordance with all applicable policies and procedures of the MDE and ACOE.

6. Construction facilities: The location of the Contractor's staging area, storage area and other construction buildings on public or privately owned property required temporarily in the performance of the Work, if not shown on the Contract Documents require approval of the Resident Engineer.

B. Water Resources:

1. At all times, take measures to prevent oil or other hazardous substances from entering the ground, drainage areas, and local bodies of water.

2. Protection of Existing Wetlands and Watercourses:

a. Plan, schedule, and undertake work in a manner that will ensure the protection and preservation of existing wetlands and watercourses.

b. No construction activities should occur on the banks or within the channels of these waterways or within wetlands or their buffers without specific permit coverage provided by the USACE and MDE. This includes activities such as clearing vegetation from stream banks, placing culverts or temporary creek crossings, channelizing or straightening streams, filling wetlands with soil, or placing dams or sediment barriers across streams.

c. Install Orange Plastic Fence as specified in SECTION 01500 TEMPORARY FACILITIES AND CONTROLS to outside the perimeter of all wetlands in the work area.

3. Remove temporary "permitted" culverts, fords or bridge structures, if used; upon completion of the project and repair the area in conformance with its original condition and as specified herein.

4. Flood Plain- Management: Design and undertake work that may involve floodplains in full compliance with the National Flood Insurance Act of 1968, as amended (42 U.S.C. 4001 et seq.) and the Flood Disaster Protection Act of 1973 (P.L. 93-234, 87 Stat. 975). Executive Order 11988 (Floodplain Management) to be accommodated in all pertinent work through compliance with the DOT implementation plan as defined in FR 27148 (June 22, 1978).

5. Maryland's Chesapeake Bay Critical Area Act: regulates activities conducted within 1,000 feet of tidal waters. The contractor is responsible for adhering to applicable State and Local regulations, whichever is more stringent, pertaining to development within the Chesapeake Bay Critical Area.

C. Fish and Wildlife Resources

1. The contractor shall not alter water flows or otherwise disturb native habitat near or adjacent to the project construction area.

2. The contractor shall follow all applicable Federal, State, and local regulations and requirements pertaining to fish and wildlife resource protection and any restrictions or provisions that are provided in the bid documents.

3. The contractor shall adhere to all “time-of-year” restrictions for in-stream work as defined in the project bid documents or per the pertinent Maryland regulations.

1.14 WETLAND RECTIFICATION

A. The contractor shall not disturb wetlands unless specifically required by the contract documents.

B. If wetlands are disturbed during development, the contractor shall develop a rectification plan for submittal to the Maryland Department of the Environment (MDE) and Chesapeake Bay Critical Areas Commission (CBCA).

C. The plan shall provide for wetland functions to be rectified by planting locally indigenous species, as specified in the MDE rectification standards.

D. Maintenance

1. Rectified areas shall be managed to allow for the reversion of wetland acreage and function.

2. Rectified areas shall not be mowed, chemically treated, or otherwise manipulated so as to prevent re-generation of previous site conditions.

1.15 HISTORICAL, ARCHEOLOGICAL, AND CULTURAL RESOURCES

A. Do not use in connection with this Contract, for storage, as a staging area, or as a preparation site, any cultural resource facility, building, site, or cleared area that is, as of the date of this Contract, on or eligible for listing on the National Register of Historic Places (16 U.S.C., paragraph 470a) or listed by the Maryland Historic Trust, without the prior approval of the Engineer.

B. If the contractor identifies potential "Cultural Resources" during the project activities, they are to stop work and contact the Resident Engineer. Cultural resources may include districts, sites, buildings, structures, and objects significant in American history, architecture, archaeology, or culture

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 CONTRACTOR ENVIRONMENTAL CHECKLIST

MARYLAND TRANSIT ADMINISTRATION

ENVIRONMENTAL MANAGEMENT SYSTEM
CONTRACTOR ENVIRONMENTAL CHECKLIST

PROJECT TITLE:			
MTA PROJECT MAN./RE			
BID / RFP #:		P.O. #:	

To be completed by the Contractor Project Manager for the contracted work or service to be performed.

Will the contracted work or service include any of the following activities?

GENERAL CONTRACTOR ACTIVITIES			
Land Disturbance (Excavation, Grading, etc.)(Wetlands,Streams)	☐ Yes	☐ No	
Construction (Building / Road / Parking Lot, etc.)	☐ Yes	☐ No	
Demolition (Building / Facility, etc.)/Asbestos	☐ Yes	☐ No	
Paving (Impervious - e.g., asphalt, concrete, etc.)	☐ Yes	☐ No	
Heavy Equip Use (Excavator, Dozer, Fork Lift, etc.)	☐ Yes	☐ No	
Blasting, Rock Crushing	☐ Yes	☐ No	
Surface Preparation / Treatments (floors, roofs, walls)	☐ Yes	☐ No	
Painting / Paint Removal (Lead)	☐ Yes	☐ No	
Sandblasting / Hydroblasting	☐ Yes	☐ No	
Welding, Cutting, Soldering	☐ Yes	☐ No	
HVAC or CFC/PCB	☐ Yes	☐ No	
Bulk Fuel / Chemical Storage or Transfer	☐ Yes	☐ No	
Use of Chemicals (solvents, caustics, acids, oils, etc.)	☐ Yes	☐ No	
Purging/Repair of Distribution Lines (fuel, oil, solvents etc.)	☐ Yes	☐ No	
Use of Herbicides, Pesticides, or Insecticides	☐ Yes	☐ No	
Well Drilling	☐ Yes	☐ No	
Discharge to Storm Drains	☐ Yes	☐ No	
Discharge to Sanitary Sewer	☐ Yes	☐ No	
Solid Waste Generation / Disposal (soil, concrete, materials, etc.)	☐ Yes	☐ No	
Medical Waste	☐ Yes	☐ No	
Hazardous Waste Generation / Disposal	☐ Yes	☐ No	☐ Unsure

To be completed by the MTA Environmental Manager after a review of activities above.

This project has activities that will significantly impact the environment ☐ Yes ☐ No

☐ This Contractor Environmental Checklist is approved, no further action is needed.

☐ The Contractor Environmental Activity Statement (ED 9-4.4.6-9) needs to be completed by the contractor .
The activity statement will be provided based on the checklist by the Environmental Manager to the contractor.

Environmental Manager Signatur_____ Date: _____

Sumit Form To: Environmental Manager, 1515 Washington Boulevard, Baltimore, Md 21230

3.02 CONTRACTOR ENVIRONMENTAL ACTIVITY STATEMENT

MTA Maryland

ENVIRONMENTAL MANAGEMENT SYSTEM
CONTRACTOR / SUPPLIER
ENVIRONMENTAL ACTIVITY STATEMENT

The following information is to be filled out by the Contractor/Supplier (Please Print). Use additional pages if needed. The form shall be returned prior to the initiation of field activities to the MTA Environmental Manager at 1515 Washington Boulevard, Baltimore, Md 21230.

Contact Person: _____ Date: _____

Company Name: _____

Activities / Work Description:

Maryland Transit Administration (MTA) Site: _____

Briefly describe the activities or work to be undertaken by your company at the MTA site.

_____

_____

_____

Training:

Your employees shall be trained per applicable federal, state, and local environmental regulations and standards. Training records shall be made available upon request. Describe the training that your employees receive.

_____

_____

Land Disturbance:

Will the activities or work you perform require the disturbance of land in an area greater than 5000 square feet? **YES or NO**

If YES, how will you comply with Erosion and Sedimentation Control requirements?

_____

_____

Air Emissions:

Will the activities or work you perform produce or cause the release of any air emissions? **YES or NO**

If YES, list the air emissions and the method for preventing impact to the environment.

_____

_____

Water Discharges:

Will the activities or work you perform produce or cause the release of any wastewater to storm drains, streams, ditches, the land surface or sanitary sewers? **YES or NO**

If YES, how will the wastewater be handled?

_____

_____

Materials and Supplies Usage / Storage:

What materials / supplies (fuel, oil, bulk chemicals, etc.) will you be handling or bringing on site to perform the contracted work? Describe how you will prevent spills and comply with proper management requirements (such as secondary containment). Has MTA approved the products for use? Describe your ability to react to spills if they occur.

_____

_____

_____

Solid Waste Generation:

Will the activities or work you perform result in the generation of solid waste, medical waste and / or universal waste? Has laboratory analysis been performed? **YES or NO**

If YES, list the amounts and the types of wastes expected and the proposed disposal method.

_____

_____

_____

Hazardous Waste Generation:

Will the activities or work you perform result in the generation of hazardous waste? **YES or NO**
Has laboratory analysis been performed?

If YES, list the amounts and the types of wastes expected and the proposed disposal method.

_____

_____

_____

Waste Recycling:

Are any wastes generated to be recycled? **YES or NO**

If YES, list the recyclables, where and how they will be recycled.

_____

_____

_____

Energy:

Will the activities or work consume energy? **YES or NO**
(Electricity, compressed air, natural gas, steam, etc.)

If YES, explain what type of energy will be consumed, and how you will minimize consumption.

_____

_____

_____

LEED Construction:

Is this project subject to scoring under the Leadership in Energy and Environmental Design (LEED) criteria? **YES or NO**

If YES, what is the target level sought? _____

Other:

Are there any other ways in which your activities will affect or protect the environment? **YES or NO**

If YES, please describe below.

_____

_____

_____

Information:

Company Name: _____

Contact: First Name: _____ Last Name: _____ Title: _____

Address: _____ City: _____ State: _____

Phone: _____ Fax: _____ Email: _____

Secondary Contact: _____ Sec. Phone: _____

Environmental Agreement

My company and subcontractors that I may bring to the site will abide by all environmental regulations and policies whenever on the property.

The MTA Environmental Manager will communicate applicable changes to the Environmental Management System to my company. Retraining of affected individuals will be conducted, as appropriate.

For questions or additional information contact the Environmental Management at (410) 454-7317.

Print Name: _____ Title: _____

Signature: _____ Date: _____

MTA Environmental Review

A review of the above-submitted document has been found to be:

☐ COMPLETE - approved, no further action is needed.

☐ INCOMPLETE - a response must be received by: _____

Environmental Manager Signature: _____ Date: _____

PROJECT TITLE:		BID/RFP#:		P.O.#:	

PART 4: MEASUREMENT AND PAYMENT

4.01 WASTE HANDLING

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.02 STORMWATER MANAGEMENT

A. The work required under this Section will not be measured for payment, except as noted below.

B. Any permitting required as a result of additional work will be measured for payment as well as any stormwater control measures needed to institute this work.

4.03 CONSTRUCTION MATERIALS AND STORAGE

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.04 SPILL PREVENTION AND MANAGEMENT

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.05 SPECIAL HAZARDOUS MATERIALS

A. The work required under this Section will be requested and approved by the Resident Engineer and measured for payment.

B. Services and Equipment provided will be measured and paid for, as agreed upon in writing prior to acceptance, from the “Special Hazard Materials” allowance.

C. The payment for additional equipment or service shall include any and all costs associated with the additional equipment.

4.06 EQUIPMENT DECOMMISSIONING

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

4.07 CONTAMINATED SOILS AND GROUNDWATER

A. Disposal of Contaminated Soil shall be measured by the ton and as documented by the authorized receiving facility.

B. Disposal of Contaminated Soil shall be paid at the unit bid price for "*Contaminated Soil Disposal*" indicated on the Unit Price Schedule.

C. Disposal of Contaminated Groundwater by any approved means shall be measured by the gallon.

D. Disposal of Contaminated Groundwater shall be paid at the unit bid price for "*Contaminated Groundwater Disposal*" indicated on the Unit Price Schedule.

4.08 WETLAND RECTIFICATION

A. The work required under this Section will be requested and approved by the Resident Engineer and measured for payment.

B. Services and Equipment provided will be measured and paid for, as agreed upon in writing prior to acceptance, from the "Wetland Rectification" allowance.

C. The payment for additional equipment or service shall include any and all costs associated with the additional equipment.

END OF SECTION

SECTION 01600

PRODUCTS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies general requirements for products, including the handling, transportation, and storage thereof, and the use of trade names and alternatives.

1.02 DEFINITIONS:

A. Products are defined as new material, machinery, components, equipment, fixtures, and systems needed to complete the Work. Machinery and equipment used for preparing fabricating, conveying and erecting of the Work are not included. Products may also include existing materials or components required for reuse.

1.03 QUALITY OF PRODUCTS:

A. Products provided shall be new, except as approved in PDR and FDR Phase. The products shall be manufactured, handled, and used so as to ensure completed work in accordance with the Contract.

1.04 HANDLING AND TRANSPORTATION:

A. Handle and transport products in accordance with manufacturer's instructions.

B. Handling:

1. Avoid bending, scraping, or overstressing product. Protect projecting parts by blocking with wood, by providing bracing, or by other approved methods.

2. Products shall be protected from soiling and moisture by wrapping or by other means.

3. Small parts shall be packaged in containers such as boxes, crates or barrels to avoid dispersal and loss. Firmly secure an itemized list and description of contents to each container.

C. Transportation:

1. Loading, transporting, unloading and storage of all products shall be conducted such that they are kept clean and free from damage.

1.05 STORAGE AND PROTECTION:

A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible.

B. Provide sheltered, weatherproof or heated weatherproof storage as required for products subject to weather damage.

C. Provide blocking, platforms or skids for products subject to damage by contact with ground.

D. Store packaged materials in their original unbroken package or container.

E. Provide off-site storage and protection when site does not permit on-site storage or protection.

F. Protect products from damage during warehousing operations.

1.06 TRADE NAMES AND ALTERNATIVES:

A. For convenience in designation on the Contract Drawings or in the Specifications, certain products to be incorporated in the work may be designated under trade names or the names of manufacturers and their catalog information.

B. Except in those instances where the product is designated to match others in use in a particular improvement either completed or in the course of completion, the use of an alternative products which the Contractor represents to be of at least equal quality and of the required characteristics for the purpose intended will be reviewed and approved during PDR and FDR phase, subject to each of the following requirements:

1. The burden of proof as to the quality and suitability of alternates shall be upon the Contractor and he shall furnish all information necessary as required by the Engineer at no additional cost to the Administration. The Engineer shall be the sole judge as to the quality and suitability of the alternate product.

2. Where the use of an alternative product involves modification to the design or to existing installation, the Contractor shall submit for approval to the Engineer. The Contractor shall be solely responsible for the changes and modifications resulting from such use of alternative products.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 PRODUCTS:

A. The work required under this section shall not be measured separately.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 01731

CUTTING AND PATCHING

PART 1: GENERAL

1.01 DESCRIPTION:

A. The Work of this Section consists of performing all cutting, fitting, or patching required to:

1. Install new construction penetrations of, or connections to existing construction

2. Repair work resulting from demolition

3. Make all parts fit properly

4. Uncover work to permit the installation of ill-timed work, or to permit the observation of covered work which was required to be observed prior to covering

5. Remove and replace work not conforming to requirements of Contract Documents

6. Remove samples of installed work as may be required for testing

B. Do not endanger any work by cutting or altering work or any part of it.

C. Related Work Specified Elsewhere:

1. Section 01110 – General Requirements

2. Section 01300 - Submittals

1.02 SUBMITTALS:

A. Submit written notice to the Administration requesting permission to proceed with the cutting before any cutting which could affect structural safety of the structures (CDRL). These submittals shall be in accordance with SUBMITTALS, Section 01300, and with the additional requirements as specified for each.

B. Provide manufacturer’s standard catalog data for all items described in this specification indicating conformance and compliance with standards and criteria indicated (CDRL).

C. Manufacturer’s description, shop drawings, installation and operational instructions (CDRL).

D. Compliance with NEC requirement to be listed and approved.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

3.01 GENERAL:

A. Installed work shall be in accordance with applicable requirements of NFPA 70 and shall comply with the current version of the NEC and local codes.

B. Materials and equipment shall be installed and connected as recommended by the manufacturer

C. Repair or replace all surrounding surfaces, finishes, structures or materials damaged or lost during any phase of work performed under the Contract.

PART 4: MEASUREMENT AND PAYMENT

4.01 CUTTING AND PATCHING:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 01732

SELECTIVE DEMOLITION

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes the following:

1. Demolition and removal of selected portions of sidewalk, pavers, curbing, pavement, or foundations.

2. Demolition and removal of selected site elements.

3. Repair procedures for selective demolition operations.

B. Related Work Specified Elsewhere:

1. Section 01110 – General Requirements

2. Section 01300 – Submittals

3 Section 01731 – Cutting and Patching

1.02 CONDITIONS & REQUIREMENTS:

A. Refer to Final contract documents approved by Engineer for any other conditions or requirements referenced elsewhere.

1.03 DEFINITIONS:

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to the Engineer ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse and reinstall them where indicated.

D. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

1.04 MATERIALS OWNERSHIP:

A. Except for items or materials indicated to be reused, salvaged and delivered to MTA, reinstalled, or otherwise indicated to remain,

demolished materials shall become the property of the Contractor and shall be removed from Project site.

1.05 SUBMITTALS:

A. Proposed Dust-Control and Noise-Control Measures (CDRL): Submit statement or drawing that indicates the measures proposed for use, proposed locations, and proposed time frame for their operation. Identify options if proposed measures are later determined to be inadequate. Note: If the proposed hours are outside the normal business day, the Contractor shall comply with all local ordinances during this period of operation.

B. Schedule of Selective Demolition Activities (CDRL): Indicate the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.

2. Interruption of utility services.

3. Coordination for shutoff, capping, and continuation of utility services

4. Locations of temporary partitions and means of egress.

C. Inventory (CDRL): After selective demolition is complete, submit a list of items that have been removed and salvaged.

D. Predemolition Photographs or Videotape (CDRL): Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by selective demolition operations. Submit to the Engineer in accordance with Section 01300.

1.06 QUALITY ASSURANCE:

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with local hauling and disposal regulations.

B. Standards: Comply with ANSI A1O.G and NFPA 241.

C. Maintain access to existing walkways, corridors, entrances and other adjacent occupied or used facilities.

1. Do not close or obstruct walkways, corridors, entrances and other occupied or used facilities.

D. Do not disturb hazardous materials or items suspected of containing hazardous materials; notify Engineer immediately.

E. Selling of removed items or materials on-site will not be permitted.

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations or provide for alternative, such as fire-watches, etc. operations.

PART 2: PRODUCTS

2.01 REPAIR MATERIALS:

A. Use repair materials identical to existing materials.

1. If identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible. Provide the Engineer with the documentation to support this alternative.

2. Utilize only materials whose installed performance equals or surpasses that of existing materials.

B. Comply with material and installation requirements specified in other Sections.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Verify that utilities have been disconnected and capped. Provide documentation of same to the Engineer.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, utilities or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to the Engineer.

E. Perform due diligences during the work as to detect and avert hazardous condition form occurring.

3.02 UTILITY SERVICES:

A. Existing Utilities: Maintain all services required by the Administration and surrounding facilities and protect them from damage during demolition operation.

B. Do not interrupt existing utilities serving occupied or operating facilities unless notice has been given to these facilities and that the authorized in writing has been provided by the utility and provided to the Engineer. Provide services during interruptions to existing utilities, as acceptable to Utilities affected.

1. Provide at least 5 days notice to the Engineer and all others concerned if shutdown of service is required during changeover.

C. Utility Requirements: Refer to the Utilities companies guides for shutting off, disconnecting, removing, and sealing or capping utilities. Do start selective demolition work until utility disconnecting and sealing have been completed and verified by the Utility and written notification of same has been supplied to the Engineer.

3.03 PREPARATION:

A. Dangerous Materials: Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from authorities having jurisdiction. Provide alternate routes around closed or obstructed ways if required by governing regulations.

2. Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction.

3. Protect existing site improvements, appurtenances, and landscaping to remain.

4. Erect a plainly visible fence around drip line of individual trees or around perimeter drip line of groups of trees to remain.

C. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

1. Provide protection to ensure safe passage of people around selective demolition area and to and from occupied portions of building.

2. Provide temporary weather protection, during interval between selective demolition of existing construction on exterior surfaces and new construction, to prevent water leakage and damage to structure and interior areas.

3. Protect walls, ceilings, floors, and other existing finish work that are to remain or that are exposed during selective demolition operations.

4. Cover and protect furniture, furnishings, and equipment that have not been removed.

D. Temporary Enclosures: Provide temporary enclosures for protection of existing building and construction, in progress and completed, from exposure, foul weather, other construction operations, and similar activities. Provide temporary weathertight enclosure for building exterior.

1. Where heating or cooling is needed and permanent enclosure is not complete, provide insulated temporary enclosures. Coordinate enclosure with ventilating material drying or curing requirements to avoid dangerous conditions and effects.

E. Temporary Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

F. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of construction to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.04 POLLUTION CONTROLS:

A. Dust Control: Use water mist, temporary enclosures, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations.

1. Do not use water when it may damage existing construction or create hazardous or objectionable conditions, such as ice, flooding, and pollution.

2. Wet mop floors to eliminate trackable dirt and wipe down walls and doors of demolition enclosure. Vacuum carpeted areas.

B. Disposal: Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

1. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

C. Cleaning: Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

3.05 SELECTIVE DEMOLITION:

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space starting flame-

cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.

5. Maintain adequate ventilation when using cutting torches.

6. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

7. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

8. Dispose of demolished items and materials promptly.

9. Return elements of construction and surfaces that to remain to condition existing before selective demolition operations began.

B. Removed and Salvaged Items: Comply with the following:

1. Clean salvaged items.

2. Pack or crate items after cleaning. Identify contents of containers.

3. Store items in a secure area until delivery.

4. Transport items to area designated by the Engineer

5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items: Comply with the following:

1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.

2. Pack or crate items after cleaning and repairing. Identify contents of containers.

3. Protect items from damage during transport and storage.

4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling selective demolition items may be removed to a suitable, protected storage location during selective demolition and

cleaned and reinstalled in their original locations after selective demolition operations are complete.

E. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals, using power-driven saw, then remove concrete between saw cuts.

F. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

G. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

3.06 PATCHING REPAIRS:

A. General: Promptly repair damage to adjacent construction caused by selective demolition operations.

B. Patching: Comply with Section 01731 - Cutting and Patching.

C. Repairs: Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

1. Completely fill holes and depressions in existing walls that are to remain with an approved masonry patching material applied according to manufacturer’s written recommendations.

D. Finishes: Restore exposed finishes of patched and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

E. Floors and Walls: Where walls or partitions that are demolished extend one finished area into another, patch and repair floor and wall in the new space. Provide an even surface of finish color, texture, and appearance. Remove existing floor and coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

1. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

2. Where patching occurs in a painted surface, apply primer and intermediate paint coats over patch and apply final paint coat over entire unbroken surface containing patch. Provide additional coats until patch blends with adjacent surfaces.

3. Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

3.07 DISPOSAL OF DEMOLISHED MATERIALS:

A. General: Promptly dispose of materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Not be permitted.

C. Disposal: Transport demolished materials off the Project site and an approved and legal disposal site.

3.08 DEMOLITION:

A. The Contractor shall cover any holes or structural imperfections left by the removal of existing materials. Its final appearance shall match its surroundings.

B. The Contractor shall become the owner of all non salvaged materials removed from the site. It shall be responsibility of the Contractor to properly dispose of all the removed material. The Administration or Baltimore City may want to keep certain salvaged materials, in which case the Contractor shall return to the Administration or Baltimore City.

PART 4: MEASUREMENT AND PAYMENT

4.01 SELECTIVE DEMOLITION:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 01733

SUPPORT FROM STATION AND BUILDING STRUCTURE

PART 1: GENERAL

1.01 CONDITIONS & REQUIREMENTS:

A. Refer to the General Conditions, Special Conditions, and other conditions or requirements referenced elsewhere.

1.02 DESCRIPTION:

A. This section provides guidelines and limitations for supporting all mechanical, electrical, plumbing or architectural items on the building structure, and for seismic bracing for all such items.

B. Design and install all support and bracing systems except as noted in the governing building codes. Provide for attachment to portions of the building structure capable of bearing the loads imposed. Designed systems shall not overstress the building.

1.03 QUALITY ASSURANCE:

A. Design and install all support systems to comply with the requirements of the International Building Code 2000) or local building code if more stringent.

B. For design of support services, the services of a structural engineer licensed in the State of Maryland.

C. For seismic bracing for mechanical, electrical and plumbing systems, refer to the Sheet Metal and Conditioning Contractors National Association, (SMACNA), “Guidelines for Seismic Restraints of Mechanical Systems and Plumbing Piping” for guidelines. Bracing design shall comply with the 2000 or local building code if more stringent.

1.04 SUBMITTALS:

A. Submit design documents during PDR and FDR phase and shop drawings for all substructures and attachment methods as specified in Section 01300, Submittal (CDRL).

B. For all support systems, submit structural calculations and details prepared and signed by the Sub-Contractor’s licensed engineer which include all resultant forces applied to the building structure (CDRL). Do not

overstress building structure. Calculations will be reviewed for compliance with design criteria, not for arithmetic.

SUPPORT FROM STATION AND BUILDING STRUCTURE

PART 2: PRODUCTS

2.01 MATERIALS:

A. Furnish all substructures and fasteners required to comply with the limitations given below. Use materials as specified in the various sections and as appropriate for the use.

B. Channel framing systems.

C. Exterior materials: Hot dipped galvanized steel or stainless steel.

SUPPORT FROM STATION AND BUILDING STRUCTURE

PART 3: EXECUTION

3.01 GUIDELINES:

A. The Contractor shall coordinate the load requirements from all sub-subcontractors so that no combination of loads exceeds the capacity of the support system, and building structure.

B. Steel Structure:

1. At both floor and roof attachments may be at the upper or the lower chord (horizontal members at top and bottom of truss). Make the point of attachment at a panel point of the truss or joists Panel points are the of the horizontal chords with the diagonal or vertical web members.

2. Hang no loads from web members (the diagonal and vertical members between chords), including the end diagonal member where the lower chord is discontinuous.

3. Make no attachments to metal decking without written approval from the If requested, inserts shall be provided where concrete fill occurs or stiffeners are welded where roof insulation occurs. Submit supported weights and details as required for such approval.

4. Do no welding on any trusses. Use bolted or clamped type connections.

5. At floor and roof joists, hang only concentric loads, not side loaded.

C. Concrete Structure:

1. Support all loads hung from concrete with cast-in-place inserts, unless drilled-in anchors are specifically approved in writing.

2. Concrete anchors must not penetrate into rebar. Where the anchor boring indicates the presence of patch hole with an epoxy type grout and relocate anchor 12 diameters away.

3. At waffle slabs, use the cast in place miscellaneous framing inserts in so far as possible. Provide all additional cast in place inserts. Use drilled in inserts or power driven fasteners only if cast in place inserts not practical to use, and only if in writing by the Administration.

4. At waffle dome slabs and bottom of ribs, power driven or drilled-in anchors not over diameter and not more than 1-⅛" into concrete are allowed.

5. For dome slab, pre-set inserts, drilled-in expansion anchors or bolts drilled through slab are allowed.

6. Drilled-in expansion anchors in sides of waffle ribs must be 6" above bottom.

D. Wood Structure:

1. Support no loads from plywood deck.

2. At 2 x 4 stiffeners of roof panels, hang no loads.

3. Place all fasteners for hanger support within the middle ⅓ of the depth.

3.02 SEISMIC BRACING:

A. Seismic bracing shall satisfy requirements of the local building codes and the latest IBC in effect.

B. The value for I (importance factor) shall be assumed to be no less than for local building codes and no less than 1.5 for the IBC.

C. Design and install seismic bracing so as not to ground out vibration and sound isolation items.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. Support from Station and Building Structure will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 01780

CONTRACT CLOSE OUT

PART 1: GENERAL

1.01 DESCRIPTION:

A. This section specifies the requirements for contract close out. This Section includes:

1. Closeout Procedures
2. Punch List
3. Final Cleaning
4. Adjusting
5. Project Record Documents
6. Operation and Maintenance Data
7. Warranties

B. Related Work Specified Elsewhere

1. GP-9.04 Acceptance and Final Payment
2. SECTION 01300 – Submittals
3. SECTION 01500 – Temporary Facilities and Controls
4. SECTION 01570 – Environmental Protection

1.02 CLOSEOUT PROCEDURES:

A. Submit written certification that Contract documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for the Engineer's inspection (CDRL).

B. Provide submittals to Engineer that are required by governing or other authorities (CDRL).

C. Submit Application for Payment in accordance with the milestones.

1.03 PUNCH LIST:

A. Notify the Engineer at least ten (10) days in advance of the desired date for the walk through to determine the final items for completion. This walk through must be done when the job is 95 percent complete or better.

B. The following attendees are required:

1. Contractor
2. Engineer
3. Project Designer
4. Inspectors
5. Administration Safety Representative
6. Major Subcontractors

C. The list compiled by the Engineer and circulated to the attendees does not represent the final list and therefore can be added to until final system acceptance has been acknowledged by the Administration of any item or items discovered after the walk through has been completed.

D. The Contractor must complete all items on the list to the satisfaction of the Engineer before final acceptance will be made.

1.04 FINAL CLEANING:

A. Execute the final cleaning prior to final inspection.

B. Mechanically clean debris from the drainage system.

C. Clean and remove waste, surplus materials, rubbish, and construction facilities from all areas occupied by the Contractor for any purpose.

1.05 ADJUSTING:

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.06 PRODUCT RECORD DOCUMENTS:

A. Maintain on site, one set of the following record documents; recording actual revisions to the work:

1. Contract Drawings.

2. Specifications.

3. Addenda.

4. Change Orders and other modifications to the Contract.

5. Reviewed shop drawings, product data, and samples.

6. Submit proof of updated As-Built Drawings as part of the monthly pay request.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Specifications: Legibly mark and record at each Product section a description of actual Products installed, including the following:

1. Manufacturer's name and product number.

2. Product substitutions or alternates utilized.

3. Changes made by Addenda and Modifications.

E. Record Documents and Shop Drawing: Legibly mark each item to record actual construction including:

1. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.

2. Field changes of dimension and detail.

3. Details not on original Contract Drawings.

F. Submit approved documents to the Engineer prior to final application for Payment.

1.07 OPERATION AND MAINTENANCE DATA:

A. As specified in Section 01301.

1.08 WARRANTIES:

A. Provide duplicate notarized copies.

B. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

C. Provide Table of Contents and assemble in three-ring vinyl binder with durable cover.

D. Submit prior to final Application for Payment.

PART 2: PRODUCTS

NOT USED

4.

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 CLOSE OUT:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 02310

EXCAVATION AND BACKFILL

PART 1: GENERAL

1.01 DESCRIPTION

A. This work includes excavation and backfill as required.

B. Related Work Specified Elsewhere:

1. Section 01110 – General Requirements

PART 2: PRODUCTS

2.01 MATERIALS:

A. Backfill:

1. Maximum dry density and optimum moisture content shall be per AASHTO T180.
2. Plasticity limit shall be per AASHTO T90 and ASTM D4318.
3. Liquid Limit shall be per AASHTO T89.
4. Material partial size shall be no greater than three inches and not exceeding one inch with nine inches of finished grade.
5. Free of organic matter, debris, refuse, frozen materials.

B. Graded Aggregate

1. Graded Aggregate meeting the following criteria:

Sieve Size	Percent Passing	Tolerance
2"	100	-3
1-1 /2"	95-100	±5
3/4"	70-92	±10
3/8"	50-70	6-10
No.4	35-55	6-10
No. 40	12-25	5-6
No. 200	0-8	5-6

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS:

A. Notify Miss Utility prior to commencement of excavation work.

B. Test pits may be required for location of existing footings, utilities, and structures. It shall be the responsibility of the contractor to determine the location of underground structures and utilities by the utilization of test pits prior to the excavation operations. Each test pit shall be backfilled and compacted as specified.

C. All excavation contiguous to existing pavements and structures shall be sheeted, shored, braced, and supported in a substantial manner to prevent settlement, movement, or damage to the pavement or structure. Excavated material shall not be placed in any manner that may endanger any structure and shall be kept out of waterways.

D. All suitable material removed from the excavation shall be placed in backfill or stored for future use. Excavated material shall not be wasted without permission of the MTA. Boulders, logs or other unforeseen obstacles encountered shall be removed. Unsuitable material shall be transported and disposed of in an approved disposal area.

E. Protect the surrounding areas from migration of sediments.

F. Concrete and brick pavers shall be removed within the limits of disturbance, salvaged, counted, crated, and securely stored for reinstallation upon completion of excavation and backfill operations. The contractor shall replace in kind all pavers damaged, stolen, or missing at no cost to the administration.

G. All concrete of brick pavers to be reinstalled around foundations, stub-ups, and poles shall be neatly cut with a wet saw. Masonary hammers shall not be permitted to cut/break pavers.

H. All concrete and asphalt pavement sections to be removed shall be neatly cut with wet saw at limit of disturbance prior to removal.

I. Maintain separation of excavated materials; including but not limited to soil, ballast, stone, and mulch; to avoid cross contamination of individual materials during excavation, backfill, and compaction operations.

J. Replace all materials fouled by excavation, backfill, and construction operations.

K. Surrounding asphalt, pavers, and concrete surface areas shall be protected with ¾ inch plywood and heavy filter cloth during excavation, backfill and compaction operations.

L. Contractor shall protect surrounding site, plantings, and trees from damaged during excavation, backfill and compaction operations. Contractor shall replace any damaged plantings and trees per the Engineer's request at no cost to the Administration.

M. Remove all water, frozen material, snow, and ice from excavated area prior to placement of backfill.

N. Fill material weaving, creeping or pumping beneath roller or tamper shall be sufficient evidence that the moisture content of the fill material is excessive and that required compaction has not been achieved.

O. Drainage and swale areas disturbed by excavation work shall be restored with material in kind as approved by the engineer.

P. The existing structural elevations in the Contract Documents shall be considered as approximate only.

Q. When concrete is to rest on an excavated surface other than rock, special care shall be taken not to disturb the bottom of the excavation.

R. If the excavation will not stand plumb, the Contractor shall furnish and install sheeting, shoring, and/or forms as required. Installed sheeting, shoring, and forms shall be removed.

S. The design of sheeting and shoring shall be the responsibility of the Contractor. When the material retained by the sheeting and shoring is greater than 6 ft high, the details, procedures, and computations shall be submitted.

T. Forms used for footings shall be removed and the void between the footing and embankment shall be backfilled with subfoundation concrete or tamped fill utilizing graded aggregate. The material shall be compacted to not less than 92 percent of the maximum density when tested in conformance with T 180, Method C. Subfoundation concrete shall be used for this backfill when footings are submerged. Working drawings for forms used for footings are not required to be submitted for approval unless directed by the MTA or the footing exceeds 6 ft. However, working drawings for forms are required for footings of any thickness in submerged areas, cofferdams and adjacent to railroad tracks.

U. All excavated spaces resulting from structure excavation not occupied by the portions of the permanent work shall be backfilled with suitable material. The backfilling shall be carried to the surface of the surrounding

ground or grade as specified in the Contract Documents. Borrow shall not be used until the available project excavation is exhausted. The top surface of the backfilled areas shall be neatly graded. Backfill compaction shall conform to the following:

1. Immediately after spreading of each layer, the material shall be compacted with compaction equipment approved by the MTA. Rolling shall be done in a longitudinal direction along the embankment, beginning at the outer edges and progressing towards the center. The travel paths of traffic and equipment shall be dispersed over the width of the embankment to aid in obtaining uniform compaction.

2. Material 1 ft below the top of sub-grade shall be compacted to not less than 92 percent of the maximum dry density as specified in T 180. Material in the top 1 ft shall be compacted to not less than 97 percent of the maximum dry density. In-place density shall be determined by MSMT 350 or 352. When necessary, the layer shall be wetted or dried in order to compact the layer to the required density. The resultant moisture content of material, when finally compacted to required density, shall be within two percentage points of optimum.

3. Mechanical or vibratory tampers may be used. This method of compaction shall be used wherever materials cannot be adequately compacted by other methods approved by the MTA. The approved material to be compacted shall be placed in horizontal layers not to exceed 6 in. loose depth over the entire area to be tamped and uniformly compacted by means of mechanical or vibratory tampers. The moisture and compaction requirements shall conform to as specified in 2.01.A. Tamping may be required over additional widths when the material cannot be adequately compacted by other means.

V. Backfilling against various structures shall be as follows:

1. Backfilling against brick masonry is not permitted until seven days after completion of the section.

2. Backfilling is not permitted until curing is completed and the concrete has achieved 80 percent of the specified compressive strength.

3. Fill placed around footings, culverts and piers shall be deposited on both sides to approximately the same elevation at the same time.

4. The bed for backfill shall be built up in horizontal layers so that at all times there is a horizontal berm of uniformly compacted material behind the structure for a distance at least equal to the height of the abutment or wall remaining to be backfilled, except insofar as undisturbed material protrudes into this area.

PART 4: MEASUREMENT AND PAYMENT

4.01 EXECAVATION AND BACKFILL:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 02370

EROSION AND SEDIMENT CONTROL

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work specified in this Section includes the application of measures to control soil erosion throughout the life of the project.

PART 2: PRODUCTS

2.01 STABILIZED CONSTRUCTION ENTRANCE:

A. Geotextile Fabric Class C:

Geotextiles shall conform to the class specified in the Contact documents. The geotextile shall be manufactured from fibers consisting of long chain synthetic polymers, composed of a minimum 85 percent by weight of polyolephins, polyesters or polyamides. The geotextile shall resist deterioration from ultraviolet exposure. Geotextiles used in the construction of silt fence shall contain sufficient amounts of ultraviolet ray inhibitors and stabilizers to provide a minimum of 12 months of expected usable construction life at a temperature range of 0 to 120 F (-18 to 49 C).

All values specified are minimum or maximum roll values.

Geotextile shall have a 0.010 cm/sec minimum permeability when tested in conformance with D 4491, and an apparent minimum elongation of 20 percent when tested for conformance with the grab tensile strength requirements specified below. Geotextiles shall also conform to the following additional requirements:

MAXIMUM APPARENT OPENING SIZE mm	GRAB TENSILE STRENGTH lb (N) min	MINIMUM BURST STRENGTH psi (Mpa)
0.30	200 (890)	320 (2.2)

Sewing of the geotextile will be allowed provided it conforms to the following:

1. Seams shall be either “J” or “butterfly” type and shall utilize a lock stitch.

2. Seams shall conform to the tensile strength requirements for the geotextile when tested across the seam.

3. The thread for seaming shall be of equal or greater durability than the geotextile itself.

B. Stone: As required.

2.02 SILT FENCE: As required.

2.03 PORTABLE SEDIMENT TANK: As required.

2.04 TEMPORARY SEEDING: As required.

2.05 INLET PROTECTION: As required.

PART 3: EXECUTION

3.01 GENERAL REQUIREMENTS:

A. All erosion and sediment components and installations shall comply with the 1994 Maryland Standards and Specifications for Soil Erosion and Sediment Control. The Contractor shall conduct an Erosion and Sediment Control meeting with MDE seven days prior to start of construction. MDE shall be notified in writing to 2500 Broening Highway/Baltimore/MD 21224, or by phone at 410-631-3510.

B. The Contractor shall assign to the project an employee to serve as the erosion and sediment control manager. The designated employee shall be experienced in all aspects of construction and have satisfactory completed the Erosion & Sediment Control Training Program pursuant to Natural Resources Article 8-1103.1.

3.02 SEQUENCE OF CONSTRUCTION:

A. The Contractor shall design and abide by a sequence of construction plan including erosion and sediment control plans as specified within the Contract Documents. In the event that this sequence requires modifications for any reason, the Contractor shall immediately notify the Engineer and MDE for approval.

3.03 INSTALLATION AND MAINTENANCE:

A. The Contractor shall install and maintain all erosion and sediment control measures as specified within the Contract Documents ever when the project is temporary closed down.

3.04 REMOVAL:

A. When the construction area for each sediment control measure is stabilized, the Contractor shall remove the measure with the prior written approval of MDE's Sediment Control Inspector and permanently stabilize the areas disturbed by this removal. All material removed shall become the property of the Contractor.

PART 4: MEASUREMENT AND PAYMENT

4.01 EROSION AND SEDIMENT CONTROL:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 02720

AGGREGATE BASE COURSE

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section specifies the construction of aggregate base courses for flexible pavement, sidewalks, curbs and gutters.

1.02 SUBMITTALS:

A. At least 30 days prior to the start of constructing the base course, the Contractor shall submit to the Engineer for approval, proposed plants, equipment, and material sources (CDRL).

1.03 EQUIPMENT:

A. All equipment, including the production plant and on-site equipment, shall be subject to approval by the Engineer. The plant shall be available for inspection by the Engineer at least 48 hours prior to the start of construction operations.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Graded Aggregate for Base Course shall meet the requirements of SHA Section 901.01.

2.02 PRODUCTION PLANTS:

A. Production Plants shall meet the requirements of SHA Section 915.

PART 3 - EXECUTION

3.01 WEATHER:

A. Temperature and Surface Conditions: Graded aggregate base shall be placed only when the ambient air and surface temperature is at least 32°F and rising. No material shall be placed on a frozen subgrade.

B. Precipitation: Construction shall not take place during precipitation. When precipitation has occurred during the previous 24 hours, the Engineer will

determine if the subgrade is sufficiently dry. Any material en route from the plant to the job site may be placed at the Contractor's risk.

3.02 SUBGRADE PREPARATION:

A. The Contractor shall protect the subgrade against damage from all causes. Any part of the subgrade that is damaged shall be repaired or replaced by the Contractor at its own expense in a manner acceptable to the Engineer.

B. The subgrade shall be constructed as specified in Section 02315, the Contract Documents, and as approved by the Engineer. If traffic, including construction equipment, is allowed to use the subgrade foundation or preceding layer, it shall be distributed over the entire width of the course to aid in obtaining uniform and thorough compaction. If ruts are formed, they shall be removed by reshaping and recompacting the affected area as specified in Section 02315.

3.03 TRANSPORTATION:

Mixed base materials shall be handled and transported in a manner that minimizes segregation and loss of moisture. All loads shall be covered in conformance with State laws unless hauling is off road and is approved by the Engineer. Dumping into piles, hauling over the completed base course, and stockpiling of material on the job site is prohibited unless approved by the Engineer.

3.04 SPREADING:

The base material shall be uniformly spread without segregating the coarse and fine particles, in layers of approximately equal thickness, to provide the specified planned depth. Shoulders or berms not less than 2 ft wide shall be built up on each side of the base to the top elevation of each uncompacted layer unless the base is placed against concrete curbs or gutters.

3.05 GRADE OR FINISHED SURFACE CONTROL:

The surface of the base material shall be brought to line and grade and shaped to the specified cross section. Grades shall be set longitudinally and transversely with fixed controls not to exceed 25 ft spacing. The surface material shall be compacted and smoothed over its full width using a smooth faced steel wheeled roller, if rolling is not feasible, by mechanical tampers and vibratory compactors as approved by the Engineer. The finished grade shall not deviate more than ½ in. from the established grade.

3.06 FINISHING:

The surface of the base material shall be shaped to the required lines, grades and cross section specified in the Contract Documents.

3.07 COMPACTION:

A. Immediately after placement, the base material shall be compacted to the required density. During compaction operations, the moisture content of the material shall be maintained within 2 percent of the materials optimum moisture. The optimum moisture content and maximum dry density of graded aggregate base shall be determined as specified by MSMT 321.

B. Graded Aggregate Base shall be compacted to a density not less than 97 percent of the maximum dry density. In-place density shall be measured as specified in MSMT 350 or 352.

C. Compaction operations shall begin at the sides of the each course; overlap the shoulder or berm at least 1 ft and progress toward the center. The compaction operation shall continue until all compaction marks are eliminated.

3.08 MAINTENANCE:

During construction and after completion of the base course, the Contractor shall maintain the base course and protect it against damage from all causes. Any part of the base course that is damaged shall be repaired or replaced for the full depth by the Contractor at its own expense in a manner acceptable to the Engineer.

PART 4 - MEASUREMENT AND PAYMENT

4.01 AGGREGAATE BASE COURSE:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 02745
HOT MIX ASPHALT PAVEMENT
PART 1 - GENERAL

1.01 DESCRIPTION:

A. This section specifies the construction of hot mix asphalt (HMA) pavement.

B. Related Work Specified Elsewhere:

1. Section 02720 – Aggregate Base Course

1.02 SUBMITTALS:

A. Contractor shall submit to the Engineer for approval a mix design and a proposed paving plan, including production plants, location of plants with respect to the project site, equipment, and material sources (CDRL). Submittals for mix design approval shall meet the requirements of all applicable State and local Agencies.

B. In accordance with Section 01300 SUBMITTALS, the Contractor shall submit to the engineer:

1. Mix design
2. Paving plan
3. Production plants
4. Location of plants
5. Equipment
6. Source information

1.03 EQUIPMENT:

A. All equipment, including the production plant and paving equipment, shall be subject to approval by the Engineer. The plant shall be ready for inspection by the Engineer at least 48 hours prior to the start of the construction operations.

B. Pavers

1. Pavers will be inspected and approved by the Engineer based upon requirements in the manufacturer's specification manual with a copy to be provided by the Contractor. The paver shall be a self-contained, power propelled unit capable of spreading the mixture true to line, grade and cross slope. The paver shall be equipped with a screed or strike off assembly, which can produce a finished surface of the required smoothness and texture without tearing, shoving or gouging the mixture. The paver shall have automatic controls for transverse slope and grade. Controls shall be capable of sensing grade from an outside reference line or ski and sensing the transverse slope of the screed to maintain the required grade and transverse slope within plus or minus 0.1 of the required slope percentage.

2. Manual operations will be permitted in the construction of irregularly shaped and minor areas, or where directed by the Engineer.

3. Whenever a breakdown or malfunction of any automatic control occurs, the equipment may be operated manually for the remainder of the workday as directed by the Engineer.

4. Reference lines or other suitable markings to control the horizontal alignment shall be provided by the Contractor, subject to the approval of the Engineer.

C. Rollers: Rollers shall be self propelled, reversible, steel wheeled or pneumatic tired. Vibratory rollers may be used, except they shall not be in vibratory mode when paving on surface courses without the approval of the Engineer. Pneumatic tire rollers shall have multiple tires of equal size with smooth tread. Wheels shall be arranged to oscillate in pairs, or they may be individually sprung. Tires shall be uniformly inflated at the operating pressure approved by the Engineer. The Contractor shall furnish the Engineer a manufacturer's table showing this data. The difference in tire pressure between any two tires shall not be greater than 5 psi. The Contractor shall provide a means for checking the tire pressure on the job at all times.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Emulsified Asphalts: M 140 or M 208 with the following exceptions: (a) Cement mixing tests are waived. (b) Grade SS-1 viscosity shall be 50 to 400 seconds at 77 F. (c) Maximum of 3.0 percent by volume of oil distillate. (d) The sieve test requirement for field samples shall be a maximum of 0.4 percent.

B. Aggregates: M 323 with the exception that the aggregate retained on the 4.75 mm sieve shall be tested for flat and elongated particles using D 4791. When recycled asphalt pavement is used in an HMA mix as defined in MSMT 412, it shall be considered an aggregate source.

C. Mix Design: Develop Superpave mix designs in conformance with R 35 except that "Table 1, Superpave Gyratory Compaction" shall be replaced with the following table:

DESIGN LEVEL	20-Year Design Traffic, ESALs	Ndesign
1	<300,000	50
2	300,00 to <3,000,000	65
3	3,000,000 to <10,000,000	80
4	10,000,000 to <30,000,000	80
5	>30,000,000	100

HMA Superpave mixes shall conform to the specification for Superpave Volumetric Mix Design, M 323, and be designed for the Equivalent Single Axle Loading (ESAL) range specified in the Contract Documents.

Crushed, recycled asphalt pavement (RAP) material and maximum of 5 percent roofing shingles from manufacturing waste may be used in the mix design. Allowable percentage and suitability for use shall be determined in conformance with MSMT 412 and M 323. When using less than 20 percent RAP, binder grade adjustments are not required. Surface mixes using 20 percent or more Rap and base mixes using more than 25 percent RAP shall be tested and evaluated in accordance with TP 62: Determining Dynamic Modulus of Hot-Mix Asphalt Concrete Mixtures, to determine plant mixing capabilities. A demonstration strip or mix verification may be required before placement. The use of RAP, not to exceed 10 percent, may be considered for applications where higher polish

value aggregates are required and in mixes requiring elastomer type polymer binder. Approval for use will be on an individual project basis by the resident Engineer. Placement areas within the project limits shall be designated by the resident Engineer. These applications shall require isolated RAP stockpiles from an identified single source. Submit documentation of RAP stockpile management, quality, and traceability for approval prior to use. Do not use crushed glass in surface mixes. Do not use roofing shingles in gap-graded mixes or mixes requiring elastomer type polymer binder.

2.02 PRODUCTION PLANTS: The plant from which the Contractor proposes to obtain material shall be approved by the resident Engineer before starting deliveries.

A. Measuring Devices. Measuring devices shall meet the current edition of the National Institute of Standards and Technology Handbook 44, except as modified by Table 915. The producer shall provide all personnel and equipment for calibrating measuring devices.

Before the plant starts any proportioning operation, and at least once each year thereafter, all measuring devices, meters, dispensers, test weights, and other measuring devices shall be inspected, tested, and certified to be in proper operating condition by an approved testing agency. During the period of operation, all measuring devices, meters, dispensers, and other measuring devices shall be tested monthly and certified for accuracy and operating condition by the producer or an approved testing agency. Any weighing device by which materials are sold by weight as a basis of payment shall be tested monthly and certified by an approved testing agency. The Engineer shall be notified at least two working days in advance of monthly scale inspections. The certifications shall state capacities, minimum graduations, loads applied, degree of accuracy, and magnitude.

Balance and zero conditions of scales shall be checked daily, and at any other time requested by the resident Engineer. The Engineer may, at any time, direct that any measuring device be tested by the producer or an outside agency if there is any doubt about the accuracy of the measuring device. Certificates of inspection shall be posted in a prominent place in the plant, and a copy shall be promptly submitted to the Engineer.

Production plant tolerances shall meet the following table:

MATERIAL	*MAINTENANCE TOLERANCE	UNIT OF MEASURE
Aggregate	0.2%	Weight
Portland Cement or Blended Hydraulic Cement of Ground Iron Blast Furnace Slag or Fly Ash	0.2%	Weight
Asphalt	0.2%	Weight or Volume
Water	1.5%	Weight or Volume
Additives	0.5%	Weight or Volume

If during the monthly check, the measuring devices are found to deviate from the allowable tolerance, they will be suspended from use until recalibrated to the Specification requirements. A price adjustment will apply to materials sold and accepted by weight that are supplied during the measuring device malfunction period when the malfunction resulted in an overpayment. The measuring device malfunction period is defined as the elapsed time between the two successive monthly checks.

B. Sampling Equipment. The producer shall provide all personnel and equipment for obtaining samples from the last practical point prior to combination with other ingredients or introduction into the mixer. Sampling of liquid binder from HMA plants shall be from a tap located at the last practical, safe point, between the binder control unit and the plant (M 156 and D 140). Sampling shall meet Tables 1 and 2 of the MSMT Manual. The sampling equipment shall have a minimum capacity of 30 lb and be positioned in a manner that will provide an accurate representation of the material being furnished. When the size of the sample is too large to be transported, approved sample splitting devices shall be available at the point of sampling that will split the sample to no more than twice the proper testing size.

C. Quality Control Laboratory. At proportioning or batching plants the producer shall provide an on-site Administration approved laboratory suitable for conducting the various tests required. An off site laboratory requires approval of the Engineer. Continued approval of the laboratory and the testing personnel will be subject to periodic inspection by the Administration. Any deficiencies shall be corrected to the satisfaction of the Engineer or the approval will be withdrawn.

PART 3 - EXECUTION

3.01 GENERAL:

A. Contractor shall document condition of all pavement sections to be removed prior to excavation.

B. All removed pavement shall be restored to the requirements of all applicable State and Local Agencies.

C. All pavement markings removed, modified, or damaged during asphalt removal and construction operations shall be restored to their pre-construction configuration with new markings.

3.02 WEATHER:

A. Pavement shall be placed only when the ambient air and surface temperature is at least 40^0 F and rising for surface course and at least 32^0 F and rising for base courses. The base shall be clean and dry and approved by the Engineer before HMA paving begins. HMA pavement shall not be placed on a frozen base. When weather conditions differ from these limits, material en route from the plant to the job site may be used at the Contractor's risk. If placement of the material is stopped by the Engineer, all material en route shall be wasted at the Contractor's expense.

3.03 FOUNDATION PREPARATION:

A. Prior to placement of paving material, the foundation shall be constructed as specified in the Contract Documents and approved by the Engineer. When paving over existing pavement, all excess crack filling or patch material shall be removed and all spalls and potholes shall be cleaned, tack coated, filled and tamped with hot mix asphalt before placement. Manholes, valve boxes, inlets, and other appurtenances within the area to be paved shall be adjusted to grade as directed by the Engineer.

B. Curbs, Gutters, and Other Supports: Where permanent curbs, gutters, edges, and other supports are planned or removed, they shall be constructed and backfilled prior to placing the HMA, which shall then be placed and compacted against them.

3.04 TACK COAT:

A. Prior to application of the tack coat, the surface shall be cleaned of all loose and foreign materials. The tack coat shall be uniformly applied to the surface by full circulation spray bars that are laterally and vertically adjustable and provide triple fanning and overlapping action so that the

resulting coating shall be residual asphalt applied at a rate of 0.01 to 0.05 gal per/yd^2 as directed by the Engineer.

3.05 HOT MIX ASPHALT PLACEMENT:

A. HMA shall be placed by the paver. Delivery of the mixture by the hauling units and placement shall be continuous. The temperature of the mixture shall not be less than 225^0 F at the time of placement. Broadcasting of loose mixture over the new surface will not be permitted.

3.06 COMPACTION:

A. Immediately following placement of the HMA, the mixture shall be compacted by rolling to an in-place density of 92.0 to 97.0 percent of the maximum density. In-place compaction shall be completed before the mixture cools below 185^0 F, as determined by a probe type surface thermometer, supplied by the Contractor and approved by the Engineer.

B. Rollers shall start at the sides and proceed longitudinally toward the center of the pavement. Successive trips of the roller shall overlap by at least one half the width of the roller, and alternate trips shall not end at the same point. After rolling is completed, no traffic of any kind will be permitted on the pavement until the pavement has cooled to less than 140^0 F or as directed by the Engineer.

3.07 JOINTS:

A. Both longitudinal and transverse joints in successive courses shall be staggered so that one is not above the other. Transverse joints shall be staggered by the length of the paver. Longitudinal joints shall be staggered a minimum of 6 in.

B. Joints shall be constructed to provide a continuous bond between the old and new surfaces. Joints shall be coated with tack coat as directed by the Engineer. In the case of surface course, the edge of the existing pavement shall be cut back for its full depth on transverse joints to expose a fresh surface and the surface shall be coated with tack coat material as directed by the Engineer. Before placing the mixture against curbs, gutters, headers, manholes, etc., all contact surfaces shall be coated with tack coat.

3.08 FIELD QUALITY CONTROL:

A. Acceptance will be determined by nuclear in-place density test data. The nuclear gauge shall be calibrated in conformance with MSMT 417.

B. The Contractor shall take a one-minute special calibration nuclear test from each lift. A special calibration nuclear test is defined as an average of

two (minimum) special calibration readings taken at the same location after rotating the nuclear gauge 180^0 degrees.

C. Nuclear test-in-place density data shall be expressed as percentage of the maximum specific gravity determined for each day's production. The in-place density shall be 92.0 to 97.0 percent.

PART 4: - MEASUREMENT AND PAYMENT

4.01 HOT MIX ASPHALT PAVEMENT:

A. The work required under this Section shall not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 02765

PAVEMENT MARKING PAINT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This Section specifies spray paint pavement markings complete in place with all related accessories and incidentals. The work includes preparation of surfaces and furnishing and applying paint for pavement marking in accordance with the Contract Drawings or as directed by the Engineer.

1.02 SUBMITTALS:

A. Submit paint manufacturer's certification of compliance with the specified requirements (CDRL).

B. Give 48 hours advance notice of the time when pavement striping will be performed.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Traffic Paint: Provide materials conforming to the requirements of the State of Maryland Department of Transportation, State Highway Administration, Bureau of Highway Maintenance Specifications for Water Borne Traffic Paint, White and Yellow.

PART 3 - EXECUTION

3.01 EQUIPMENT:

A. Use atomizing spray-type equipment, guides, and templates designed for the purpose and which are also designed to apply stripes of uniform size and cross section, with clear cut edges and uniform thickness for the coverage specified.

3.02 LAYOUT OF THE WORK:

A. Provide sufficient control points to permit application of delineations as shown on the Contract Drawings within the tolerances specified.

3.03 APPLICATION:

A. Surface Conditions: Do not apply paint to new bituminous pavement until twenty-four (24) hours after pavement has been placed.

B. Cleaning: Clean the surface of areas to be painted of dust, dirt, laitance, oil, and other foreign substances.

C. Painting:

1. Apply all pavement markings by machine.

2. Suspend painting operations when wind conditions are such that blowing of spray-applied paint and deposit of dust on newly applied paint is likely.

3. Clean painting equipment, guides, and templates at the end of each day's work, or more often if necessary, to obtain application of pavement marking of the quality specified.

3.04 CORRECTIVE MEASURES:

A. Repair or remove and reapply any striping that fails to satisfy the requirements indicated. Submit proposed means of cleaning, removing, or obliterating unsatisfactory striping to the Engineer for approval prior to commencing corrective work. Use materials for cleaning pavement of spills, spatter, or overspray that will not injure the paved surface.

3.05 GENERAL:

A. All pavement markings removed, modified, or damaged during asphalt removal and construction operations shall be restored to their pre-construction configuration with new markings.

B. Tolerance:

1. Width of Lines: Minus zero, plus 1/8 inch.

2. Wet Film Thickness: Minimum fifteen (15) mils

3. Location of Stripes: within two (2) inches of indicated location.

C. Job Conditions:

Weather: Apply striping paint only when the ambient air temperature is 40 degrees Fahrenheit or higher and the temperature of the surface to be painted is 45 degrees Fahrenheit or higher. If pavement is wet, allow the surface to dry for a minimum of eight (8) hours after it appears surface dry.

1. Protection of the Work: Exercise care to prevent paint from dripping on the pavement, curb and sidewalks, and remove any drippings or spillage

before they harden. Protect adjoining surfaces against over-spray or paint splash stains, throughout painting operations.

2. Scheduling of the Work: Schedule striping operation so permit paint to set and harden before the area is to be opened to traffic.

PART 4: MEASUREMENT AND PAYMENT

4.01 PAVEMENT MARKING PAINT:

A. The work required under this Section shall not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 02775

CONCRETE SIDEWALK

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work specified in this Section consists of furnishing and installing cement concrete sidewalks as indicated.

B. Related Work Specified Elsewhere:

1. Section 01300 – Submittals.
2. Section 03050 – Portland Cement Concrete.
3. Section 03300 – Cast-in-Place Concrete.

1.02 QUALITY ASSURANCE:

A. Referenced Standards:

1. American Association of State Highway and Transportation Officials (AASHTO):

2. City of Baltimore Standard Specifications

1.03 SUBMITTALS:

A. In accordance with SECTION 01300, SUBMITTALS, submit the following:

1. Working Drawings indicating construction joint and expansion joint layout, and openings (CDRL).

2. Mix design for each change of ingredients and ingredient sources, including admixtures (CDRL).

3. Certificates of Compliance to specifications of materials provided (CDRL).

PART 2: PRODUCTS

2.01 FORMS:

A. In accordance with SECTION 03300.

2.02 CONCRETE:

A. Portland Cement Concrete, 3,500 psi, conforming to SECTION 03050.

PART 3: EXECUTION

3.01 SUBGRADE:

A. Compact subgrade of all sidewalks smooth and even. Loose material from the compacted subgrade surface shall be immediately removed before placing concrete.

3.02 FORM CONSTRUCTION:

A. Set and brace forms to maintain straight and plumb lines on sides.

B. Set forms to the following grade and alignment tolerances:

1. Grade: Plus or minus 1/8 inch.

2. Alignment: Plus or minus 1/4 inch at any point and no more than 1/8 inch deviation from a 10 foot straightedge.

3.03 CONCRETE PLACEMENT:

A. Construct walkways to thickness to match existing side walk.

B. Moisten subgrade to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around structures or frames until they have been brought to the required grade and alignment.

C. Place concrete in one course monolithic construction for the full width and depth of walks.

D. Spread concrete as soon as it is deposited on the subgrade using methods that prevent segregation of the mix. Consolidate concrete along the face of the forms and adjacent to transverse joints. Use only square faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocation of joint materials.

E. Pour sidewalk concrete in alternate sections between expansion joints and allow to set and cure for a minimum of 24 hours before pouring adjacent panels or sections.

3.04 JOINTS:

A. General:

1. Construct expansion, isolation, and contraction joints true-to-line with face perpendicular to surface of the walks.

2. Construct transverse joints at right angles to the pavement centerline.

3. When the walkway is abutting existing walks, place transverse joints to align with previously paved joints.

B. Contraction Joints:

1. Provide contraction joints to section the walkway into areas to match pattern and construction of existing joints.

C. Construction Joints:

1. Place construction joints at the end of pours and at locations where placement operations are stopped for a period of more than 1/2 hour, except where such pours terminate at expansion joints.

2. Construct joints using standard metal keyway-section forms.

3.05 CONCRETE FINISHING:

A. Perform concrete finishing using machine or hand methods as required.

B. After striking off and consolidating concrete, smooth the surface by screening and floating. Adjust the floating to compact the surface and produce a uniform texture.

C. After floating, test surface for trueness with a 10 foot straight edge. Distribute concrete as required to remove surface irregularities, and refloat repaired areas to provide a continuous, smooth finish.

D. Work edges of slabs and joints with a 1/4 inch radius edging tools.

E. After completion of floating and when excess moisture or surface sheen has disappeared, complete surface finishing, as follows:

1. Broom finish to match existing concrete walks by drawing a fine-hair broom across the concrete surface. Repeat operation if

required to provide a texture to match existing walks.

F. Leave forms in place for at least 24 hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections of major honeycombing.

3.06 CURING:

A. Protect and cure finished concrete walks complying with SECTION 03300. Use moist curing methods for initial curing whenever possible. After removal of forms, extend curing to exposed edges.

3.07 REPAIR AND PROTECTION:

A. Repair or replace broken or defective walks (defects include graffiti).

B. Protect the walks from damage until acceptance of the work. Exclude pedestrians from walks for at least 3 days after placement.

C. Sweep concrete walks and wash free of stains, discoloration, dirt, and other foreign materials.

D. Provide necessary watchmen to prevent vandalism to freshly poured concrete walks.

PART 4: MEASUREMENT AND PAYMENT

4.01 CONCRETE SIDEWALK:

A. The work required under this Section shall not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 03050

PORTLAND CEMENT CONCRETE

PART 1: GENERAL

1.01 DESCRIPTION:

A. This section specifies providing Portland cement concrete, including materials, proportioning, batching, mixing, delivering and testing.

B. Portland cement concrete shall be composed of Portland cement, fine aggregate, course aggregate, and water, with or without admixtures as approved, proportioned and mixed as specified herein.

C. Classes of Concrete:

1. Classes of concrete are designated by a numeral indicating the minimum 28 day compressive strength in pounds per square inch as determined by ASTM C39

2. Each class of concrete may consist of one or more mixes determined by the maximum size of aggregate, cement factor and types of admixtures or special aggregates used.

3. Each mix within a Class shall be considered a specific type, requiring approval of the design mix.

D. When reference is made to the use of Maryland State Highway Administration Concrete Mixes (SHA Mix No. 1 to Mix No. 7), the criteria set forth in the Maryland Department of Transportation State Highway Administration Standard Specifications for Construction and Materials shall apply.

E. Related Work Specified Elsewhere:

1. Summary of Work – Section 01000

2. Concrete Reinforcement – Section 03210.

3. Cast-In-Place – Section 03300.

1.02 DESIGN CRITERIA:

A. General Requirements:

1. No material shall be introduced into the work until approval of sources has been obtained. The ADMINISTRATION reserves the right to completely or partially test any material for specification compliance.
2. Concrete mixes shall be designed to have a minimum water content per cubic yard of concrete consistent with required slump, a cement content corresponding to the appropriate water-cement ratio, the specified maximum size of course aggregate, and the required percentage of fine aggregate. Design mixes as recommended by ACI 211 for normal weight concrete. Use trial mix water cement ratio in accordance with ACI 211 as determined by the type of structure and exposure conditions, and adjust to meet specified design mix requirements. Test and report as specified herein.

3. The design mixes for each class of concrete used shall be as determined by the Contractor through an approved design laboratory and accepted by the Engineer to produce the results as specified herein.

4. For each class of concrete there shall be as many mix designs, as there are different combinations or types of ingredients, anticipated to cover the requirements of the work.

B. Strength:

1. Design concrete mixes based on the required over-design factor according to ASTM C94, and assuming a coefficient of variation equal to 15.

2. Design each class of concrete so that not more than 10 percent of the strength tests will have values less than the specified strength, and the average of any three consecutive strength tests will be equal to or greater than the specified strength.

1.03 QUALITY ASSURANCE:

A. Design Mix:

1. Once the Engineer accepts a design for any class of concrete, it shall not be varied as to source, quantity, quality, grading of materials, or proportioning, or in any other way.

2. All proposed changes shall be accomplished by preparing a new design mix as specified above.

B. Sampling and Testing:

1. Sample concrete ingredients prior to use and have them tested by an approved laboratory in accordance with the methods specified.
2. Test materials as often as necessary to verify that the materials conform to the specifications and that the quality of the product is maintained.
3. The Engineer will have the authority to inspect concrete supplier's plant and will have the authority to inspect delivery trucks to verify that plant conforms to the "Check List for Certification of Ready Mixed Concrete Production Facilities" published by the National Ready Mixed Concrete Association, and to verify delivery trucks conform to requirements specified in ASTM C94.

C. Slump:

1. Maintain the slump range at point of delivery for concrete within the following limits:

a.	Concrete pavement, pavement base sidewalk and incidental construction	2-3 inches
b.	Unreinforced concrete other than the above	1-3 inches
c.	Reinforced concrete	2-4 inches
d.	Concrete placed by pumping and concrete for filling steel shell piles	6 inches

D. Minimum cement content:

CLASS	**MINIMUM CEMENT CONTENT per CUBIC YARD**
2,500 to 3,000 psi	470 lbs.
3,500 to 4,000 psi	564 lbs.
4,500 psi	615 lbs.
5000 psi	611 lbs.

E. Reference Standards:

1. American Concrete Institute (ACI)

a. ACI 211, Guide for Use of Normal Weight Aggregates in Concrete

b. ACI 226.3R, Use of Fly-Ash in Concrete

c. ACI 301, Specifications for Structural Concrete for Buildings

d. ACI 304R, Guide for Measuring, Mixing, Transporting and Placing Concrete

e. ACI 305R, Hot Weather Concreting

f. ACI 306R, Cold Weather Concreting

g. ACI 318, Building Code Requirements for Reinforced Concrete.

2. American Society for Testing and Materials (ASTM):

a. ASTM C31, Practice for Making and Curing Concrete Test Specimens in the Field

b. ASTM C33, Specification for Concrete Aggregates

c. ASTM C39, Test Method for Compressive Strength of Cylindrical Concrete Specimens

d. ASTM C78, Test Method for Flexural Strength of Concrete (Using Simple Beam With Third-Point Loading)

e. ASTM C94, Specification for Ready-Mixed Concrete

f. ASTM C109, Test Method for Compressive Strength of Hydraulic Cement Mortars (using 2-in or 50 mm Cube Specimens

g. ASTM C143, Test Method for Slump of Hydraulic Cement Concrete

h. ASTM C150, Specification for Portland Cement

i. ASTM C172, Practice for Sampling Freshly Mixed Concrete

j. ASTM C173, Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

k. ASTM C191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle

l. ASTM C192, Practice for Making and Curing Concrete Test Specimens in the Laboratory

m. ASTM C231, Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

n. ASTM C260, Specification for Air-Entraining Admixtures for Concrete

o. ASTM C494, Specification for Chemical Admixtures for Concrete

p. ASTM C618, Specification for Coal Fly-Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete

3. Concrete Reinforced Steel Institute (CRSI), Recommended Practice for Placing Reinforcing Bars.

F. Acceptance of delivery shall be in accordance with MDOT Standard Specifications Construction and Materials, 2008 Section 902.10.

1.04 SUBMITTALS:

A. In accordance with Specification Section 01300, submit the following:

1. Samples of materials being used including names, sources and descriptions.

2. Certification that the concrete ingredients and proportions will result in a concrete mix meeting the requirements specified (CDRL).

B. Hot and Cold Weather Concreting:

1. Submit proposed methods for compliance with hot and cold weather mixing and delivery requirements (CDRL)..

2. Proposed methods for controlling temperature and plans for placing concrete taking into account the sun, heat, wind, ambient air

temperature or other limitations of facilities that will prevent proper finishing or curing (CDRL)..

C. Certificates:

1. Submit with each mix design, laboratory test reports and mill or manufacturer's certificates attesting to conformance of ingredients with specifications (CDRL)..

2. In case the source, brand or characteristic properties of ingredients need to be varied during the term of the Contract, submit revised laboratory mix report in accordance with procedures specified for original mix design (CDRL)..

3. Submit certificate stating that each admixture used is identical in composition to the sample used for acceptance testing and is compatible with all other materials in the design mix (CDRL)..

D. Batch Tickets:

1. Before unloading at the site, submit delivery ticket from concrete supplier with each batch delivered to the site setting forth the following information (CDRL).:

a. Name of supplier

b. Name of batching plant and location

c. Serial number of ticket

d. Date

e. Truck number and batch number

f. Specific job designation (Contract number and location)

g. Volume of concrete (cubic yards)

h. Specific class of concrete

i. Time loaded and amount of water added

j. Type and brand of cement

k. Weight of cement

l. Maximum size of aggregates

m. Weights of coarse and fine aggregates, respectively

n. Maximum permissible amount of water to be added at the site, if any

o. Type and amount of admixtures

p. Mix design designation

E. Test Reports:

1. Furnish to the Engineer a record of the results of tests (CDRL).

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Aggregates:

1. Transport and stock pile aggregate separately according to their source and graduations. Handle aggregates in a manner, which will prevent segregation and loss of fines or contamination with earth or foreign materials.

2. If aggregates show segregation or the different grades become mixed, re-screen the aggregates before placing them in the proportioning bins.

3. Do not use aggregates from different sources or of different graduations alternately. Mix aggregates only to obtain different graduations.

4. Do not transfer aggregates directly from trucks, railroad cars or barges to the proportioning bins when moisture content is such that it will affect the accuracy of the proportioning of the concrete mixture. In such case, stockpile the aggregates until the excess moisture drains off.

B. Packaged Cement:

1. When required, deliver cement to the mixing site in original sealed packages labeled with the weight, name of the manufacturer, brand and type specified. Store packages in watertight enclosures.

2. Do not deliver packages varying more than three percent from the specified weight.

C. Bulk Cement:

1. Store bulk cement separately from packaged cement and protect the cement to prevent deterioration from exposure to moisture and intrusion of foreign matter.

2. Provide facilities for sampling of cement at the weighing hopper or in the feed line immediately before entering the hopper.

3. Do not use different brands of cement or the same brand of cement from different sources, without approval.

PART 2: PRODUCTS

2.01 MATERIALS:

A. Portland Cement:

1. ASTM C150; Type I or Type II as indicated

2. Use only one brand and manufacturer of approved cement

B. Portland Cement Concrete:

1. In accordance with MDOT Standard Specifications Construction and Materials, 2008 Section 902.10.

C. Admixtures and Additives:

1. Air-Entraining Admixtures; AASHTO M154

2. Accelerating, Retarding and Water-Reducing Agents; AASHTO M194

3. Fly-Ash:

a. Restrictions on Use:

i. The use of Fly-Ash or other material that supports the flow of current is prohibited in any application where stray currents may be present such as the Light Rail and Metro systems.

ii. The Engineer must approve the use of Fly-Ash in any application.

b. Material Requirements:

i. Conform to the requirements of ASTM C618, Class F, except that Loss On Ignition (L.O.I.) shall not exceed 4% maximum, and Pozzolanic Activity Index with cement, not lime, shall govern.

ii. Pretest all Fly-Ash shipped for L.O.I. and fineness at no greater intervals than 50-ton lots. Document test results on each weight ticket with a certification that all material meets the specified physical and chemical requirements.

c. Proportioning:

i. Use Fly-Ash at the rate of 15 percent to 25 percent of the total cementitious material. Decrease amount during cold weather.

ii. In Fly-Ash concrete, for computational purposes, apply the water-cement ratio as well as the water-cementitious ratio (cement and Fly-Ash).

iii. Prepare extensive laboratory trial mixtures to demonstrate physical properties of the Fly-Ash concrete, including compatibility of admixtures, 28 day compressive strength, air content, slump and workability.

4. Other Pozzolanic Admixtures; ASTM C618: See Fly-Ash for restrictions on use.

5. Calcium Chloride is prohibited.

D. Water: Clean and Potable.

E. Bonding Materials:

1. Epoxy Bonding Type: Two (2) component, solvent-free, moisture-insensitive structural epoxy adhesive:

a. Sikadur 32, Hi-Mod; Sika Corporation.

b. Euco Epoxy #452 MV or #620; The Euclid Chemical Co.

c. Or Approved Equal.

2. Polyvinyl Acetate Type: re-wettable:

   a. Euco Weld; The Euclid Chemical Co.

   b. Weldcrete; The Larson Products Co.

   c. Everweld; L&M Construction Chemicals, Inc.

   d. Or Approved Equal.

3. Polymer Modified Type; non-rewettable; for use only in areas not subject to moisture:

   a. Euco-Bond; The Euclid Chemical Co.

   b. Everbond; L&M Construction Chemicals, Inc.

   c. Or Approved Equal.

F. Patching Mortar: Provide a polymer-modified cementious, 2-component, trowel-grade patching mortar:

1. For applications greater than 1 inch in depth, add a minus 1/2 inch or 3/8 inch coarse aggregate as recommended by the manufacturer.

G. Concrete Aggregate:

1. Coarse Aggregate; ASTM C33

2. Fine Aggregate; ASTM C33 modified as follow:

   a. Weighted percentage of loss not more than 12 percent weight when subjected to five cycles of the magnesium sulphate soundness test in accordance with ASTM C88.

   b. Deleterious Substances

Deleterious Substances	**Maximum percentage by Weight**
Friable particles	1.0
Coal and lignite	0.5
Material passing the No. 200 sieve	3.0
Other deleterious substances such as shale, alkali, mica, coated grains, soft and flaky particles	2.0

PART 3: EXECUTION

3.01 FIELD QUALITY CONTROL:

A. Concrete Sampling and Testing:

1. Furnish molds and concrete required for casting specimens and for the specified sampling and testing.

2. Perform slump and air content tests for each 50 cubic yards, or fraction thereof, placed.

3. Perform variability test and other tests required for each 50 cubic yards, or fraction thereof, placed.

4. Prepare one set of standard cylinders in accordance with MDOT Standard Specifications Construction and Materials, 2008 Section 902.10 and ASTM C172 for each 50 cubic yards, or fraction thereof, placed for compressive strength testing by the Engineer.

B. Tests:

1. Sample according to MDOT Standard Specifications Construction and Materials, 2008 Section 902.10, ASTM C31, C42 and C172.

2. Test for air content according to MDOT Standard Specifications Construction and Materials, 2008 Section 902.10, ASTM C231 or C173 as applicable.

3. Test for unit weight, yield, air content, cement content and unit weight according to MDOT Standard Specifications Construction and Materials, 2008 Section 902.10 and ASTM C138.

4. Test for slump according to MDOT Standard Specifications Construction and Materials, 2008 Section 902.10 and ASTM C143.

5. Test mixes with chemical additives according to MDOT Standard Specifications Construction and Materials, 2008 Section 902.10 and ASTM C494 and as required by the Engineer.

3.02 MIX EQUIPMENT:

A. Batching Plant

1. Arrangement:

a. Provide separate bins or compartments for each size or classification of aggregate and for each type of bulk portland cement

2. Compartments:

a. Provide compartments of ample size, constructed so that materials will be separated under working conditions. Equip the batching plant so that the flow of each material into its batcher is stopped automatically when the designated weight has been reached.

b. Weighing hoppers shall be constructed so as to eliminate accumulations of tare materials.

c. Weigh aggregates in separate weigh batches with individual scales, or cumulatively in on batcher on one scale. Weigh bulk cement on separate scale in a separate weight batcher.

d. Where mix water is measured by weight, do not weigh water cumulatively with another ingredient.

e. Interlock batching controls so that the charging mechanism can not be opened until the scales have returned to zero. Satisfy these requirements by semi-automatic batching system as defined in the Concrete Plant Standards of the Concrete Plant Manufacturers Bureau, with interlocking as described herein, or by an automatic batching system as defined in the Concrete Plant Standards and approved by the Engineer.

f. Provide facilities for obtaining representative samples of aggregate from each of the bins or compartments for test purposes.

g. Deliver materials from the batching equipment within limits specified in ASTM C94.

3. Water Batcher and Admixture Dispensers:

a. Provide equipment for batching water and admixtures at the batching plant except in cases where the mixing has been authorized by the Engineer to be performed at the jobsite in the paving mixers or in truck mixers.

b. Provide a device that is capable of measuring mixing water within the specified requirements for each batch. Provide mechanism for delivering water to the mixers so that leakage will not occur when the valves are closed.

c. Interlock the filling and discharge valves for the water batcher so that the discharge valve cannot open before the filling valve is closed.

d. Provide measuring devices for admixtures capable of ready adjustment to permit varying quantity of admixture to be batched. Interlock the dispenser for admixtures with the batching and discharging operations so that the batching and discharging of the mixture will be automatic.

e. If non-interlocked dispensers are permitted, check the calibration of the dispensers at intervals as required by the Engineer. Record the results of such calibration and make it available for the inspection of the Engineer.

4. Moisture Content:

a. At the time of batching, all aggregates shall have been dried or drained sufficiently to result in stable moisture content such that no visible separation of water from aggregate will take place during transportation from the proportioning plant to the point of mixing.

b. In no event shall the free moisture content of the fine aggregate at the time of batching exceed eight percent of its saturated surface-dry weight. The batch-to-batch uniformity of all aggregates shall be such that variations in moisture content within one hour do not exceed 12 pounds in the batch quantity for one cubic yard of concrete, or that a gradual change does not exceed twice the variation in a period of four hours.

c. Install and maintain in operating condition an electrically actuated moisture meter that will indicate on a readily visible scale the percentage of moisture in the fine aggregate as it is batched, within a sensitivity of one-half of one percent by weight of the fine aggregate.

5. Use scales for proportioning of the springless dial type or of the multiple beam type as follows:

a. If scales are of the dial type, the dial shall be of such size and so arranged that it may be read easily from the operating platform.

b. If of the multiple beam type, the scale shall be provided with an indicator operated by the main beam, which will give positive visible evidence of over-or-under-weight. The indicator shall be so designed that it will operate during the addition of the last 200 pounds of any weight. The overtravel of the indicator shall be at least one-third of the loading travel. Indicators shall be enclosed against moisture and dust.

c. Test scales as frequently as the Engineer may deem necessary to ensure their accuracy, at no additional expense to the ADMINISTRATION. Furnish for use in testing scales one standard 50-pound weight for each 500 pounds of batch scale capacity.

6. Recorders:

a. Provide an accurate recorder for producing a digital printout of the batch number and scales readings corresponding to each of the ingredients of each concrete batch, including zero initial readings. Indicate by name or code the individual ingredient corresponding to each weight. Indicate by pressure only each admixture measured by volume.

b. On each printout show date and time of batching, identification number identical to that of the concrete delivery ticket and codes for the mix design and for the project section.

c. Prepare the printout in duplicate and deliver one copy with its corresponding concrete delivery ticket to the Engineer as specified above.

d. House each recorder mechanism in a locked, dust-tight cabinet.

e. Place the recorder in a position convenient for observation.

7. Protection:

a. Weighing, indicating, and control equipment shall be insulated against vibration or movement of other operating equipment in the plant.

b. When the entire plant is running, the scale reading at cut-off shall vary from the weight designated by the Engineer not more than one percent for cement, one-half percent for any size aggregate, or one percent from the total aggregate in any batch.

B. Concrete Mixers:

1. General Requirements:

a. Use mechanically operated batch mixers for mixing concrete, except that batches not exceeding one third cubic yard may be hand-mixed in accordance with provisions of Article 3.03.C below.

b. Use concrete mixers of the revolving drum or pan type. Use truck mixers of the revolving drum type. Replace the pick-up and throwover blades of the revolving drum mixers when any part or section is worn one inch or more below the original dimensions of the manufacturer's design. A copy of the manufacturer's design, showing dimensions and arrangements of blades shall be available to the Engineer. Batches shall be so charged into the mixer that some water will enter in advance of cement and aggregates. All water shall be in the drum by the end of the first quarter of the specified mixing time.

2. On-Site Mixers:

a. Accomplish on-site mixing in paving or stationary type mixers. Operate mixers at the speeds recommended by the mixer manufacturer, except that revolving drum mixers shall make not less than 14 nor more than 18 revolutions per minute.

b. Operate paving and stationary mixers by an automatic timing device, which can be locked by the Engineer. Interlock the timing device and discharge mechanism so that, during normal operation, no part of the batch will be discharged until the specified mixing time has elapsed. The total elapsed time between the intermingling of damp aggregates and the discharging of the completed mix shall not exceed 30 minutes.

3.03 MIXING AND DELIVERY:

A. General:

1. Normal weight portland cement concrete placed quantities greater than two cubic yards shall be shrink-mixed concrete mixed and delivered in accordance with the requirements of ASTM C94.

B. Site Mixing:

1. Mixing of batches two cubic yards and more shall continue 60 seconds plus 15 seconds for each cubic yard in excess of two cubic yards.

2. The mixing time may be reduced to a period of not less than 60 seconds if it is demonstrated to the satisfaction of the Engineer that a shorter mixing time results in satisfactory mixing.

3. Evidence of satisfactory mixing shall consist of the variation in slump of samples, taken from the first and last quarter of the discharge, being not more than 3/4 inch from the average of the two slump values.

C. Hand Mixing:

1. Hand-mixed concrete, when authorized, shall be made in batches not larger than one-third cubic yard, and shall be mixed on a watertight, level platform.

2. Coarse aggregate shall be measured in measuring boxes, spread on the platform, and the fine aggregate spread on the coarse aggregate; the total depth of the two layers shall be not more than one foot.

3. The dry cement shall be spread on the aggregate and the whole dry mass shall be turned not less than two times.

4. Clean water shall then be evenly added, and the whole mass shall be turned not less than three times not including placing in the carriers and forms.

3.04 JOINTS AND EMBEDDED ITEMS:

A. Construction Joints:

1. Joints shall be placed only where shown on the Plans.

B. Bond new concrete with hardened concrete with one of the following methods:

1. Grout Method:

a. Roughen and clean hardened concrete of foreign matter and laitance and dampen with water.

b. Cover the hardened concrete with a one-inch layer of grout. Use grout of same material composition and proportions of concrete being poured except coarse aggregate omitted. Use the specified bonding admixture as 50% of the liquid requirement.

c. Place new concrete on grout before it has attained its initial set.

2. Epoxy Bonding Method:

a. Apply Epoxy Bonding Type Compound over existing prepared concrete in accordance with manufacturers instructions.

3. Other bonding methods must be approved by the Engineer.

C. When concreting is to be discontinued for more than 45 minutes and if the construction plane is to be horizontal, install keyways and embed dowel bars in the concrete before initial hardening. Use keyways and dowels in vertical concrete construction except when indicated or directed otherwise by the Engineer.

D. Other Embedded Items: Place sleeves, inserts, anchors and embedded items required for adjoining or related work prior to concreting. Place accurately, and support against displacement.

3.05 DRILLING AND GROUTING ANCHOR BOLTS AND DOWELS:

A. Construction Methods:

1. Drill holes for each anchor bolt or dowel to the size and depth indicated on the Contract Drawings. Do not drill into or cut or otherwise damage existing reinforcement bars. If existing reinforcement bars are encountered during the drilling operation for dowels, relocate the hole to clear the existing reinforcement as directed by the Engineer.

2. Blow clean each finished hole with an air jet and then flush with a jet of clean water.

3. Immediately prior to the grouting operation, remove all water from the hole and from the walls of the hole.

4. Mix and place the epoxy adhesive completely around the dowel bar in strict accordance with the manufacturer's recommendations, with particular attention given to manufacturer's specified time limit within which the material must be placed after mixing. Do not retemper grout that has begun to stiffen; discard such grout.

3.06 PLACING:

A. General: Conduct placement work in accordance with ACI 304.

B. Preparation:

1. Prepare formwork in advance and remove snow, ice, water and debris from within forms.

2. Pre-position expansion joint material, anchors and embedded items.

3. Thoroughly moisten subgrades to the satisfaction of the Engineer prior to placing concrete in slabs-on-grade to eliminate water loss from bottom of concrete slab.

4. Do not place concrete on frozen ground.

C. Conveying:

1. Handle concrete from mixer to final deposit rapidly by methods, which will prevent segregation or loss of ingredients to maintain required quality of concrete.

2. Do not convey concrete through aluminum or aluminum alloy.

3. Do not place concrete by pumps or other similar devices without prior written approval of Engineer.

a. When pumping is permitted, use pumping and pneumatic conveying equipment designed to handle without segregation, types, classes and volumes of concrete to be conveyed.

b. Operate pump or pneumatic equipment so that a continuous stream of concrete without air pockets is produced. Position

the discharge end of line as near to the final position of concrete as possible, but in no case more than five feet away.

c. At completion of placement, clean equipment. Discharge all debris and flushing water outside of forms.

D. Depositing:

1. Concrete shall not be dropped freely where reinforcing will cause segregation, nor shall it be dropped freely more than ten (10) feet for concrete containing the high-range water-reducing admixture (superplasticizer), or five (5) feet for other concrete.

2. Deposit in approximately horizontal layers of 12 to 18 inches.

3. Do not allow concrete to flow laterally more than 3 feet.

4. Make placement within sections continuously to produce monolithic unit.

5. Proceed with placing at such a rate that concrete that is being integrated with fresh concrete is still plastic.

6. Do not deposit concrete on concrete that has hardened sufficiently to cause the formation of seams or planes of weakness within sections.

7. Do not use concrete that has partially hardened or has been contaminated by foreign materials.

8. Do not subject concrete to procedures that will cause segregation.

9. Do not bend reinforcement out of position when placing concrete.

10. Do not place concrete in forms containing standing water.

E. Consolidation:

1. Consolidate concrete by vibration, spading, rodding or other manual methods. Work concrete around reinforcement, embedded items and into corners; eliminate all air or stone pockets and other causes of honeycombing, pitting or planes of weakness.

2. Use vibration equipment of internal type and not the type attached to forms and reinforcement.

3. Use vibrators capable of transmitting vibration to concrete in frequencies sufficient to provide satisfactory consolidation.

4. Do not leave vibrators in one spot long enough to cause segregation. Remove concrete segregated by vibrator operation.

5. Do not use vibrators to spread concrete.

6. Have sufficient reserve vibration equipment to guard against shutdown of work occasioned by failure of equipment in operation.

F. Cold Weather Concreting:

1. Temperature of concrete delivered at the job-site shall conform to the following temperature limitations:

	Minimum Concrete Temperature In Degrees F	
Air Temperature In Degrees F	For Sections With Least Dimension Less Than 12 Inches	For Sections With Least Dimension 12 Inches Or Greater
30 to 45	60	50
0 to 30	65	55

2. If water or aggregate is heated above 100 degrees F, combine water with aggregate in the mixer before cement is added. Do not mix cement with water or with mixtures of water and aggregate having a temperature greater than 100 degrees F.

3. Provide equipment for heating concrete materials and protecting concrete during freezing or near freezing weather. Do not use foreign materials or materials containing snow or ice.

4. Surfaces that the concrete is to come in contact with must be free of frost, snow or ice.

5. Concrete placed in forms shall have a temperature of 50 degrees F. or higher after placement. Maintain this temperature a minimum of 5 days. Provide additional time if necessary for proper curing.

6. Housing, covering or other protection used in curing shall remain intact at least 24 hours after artificial heating is discontinued. Do not place dependence on salt or other chemicals for the prevention of freezing.

7. Perform cold weather concreting work in accordance with ACI 306R.

G. Hot Weather Concreting:

1. Temperature of concrete delivered at the job-site shall not exceed 90 F.

2. Cool ingredients before mixing to prevent temperature in excess of 90 F.

3. Make provisions for windbreaks, shading, fog spraying, sprinkling or wet cover when necessary.

4. Perform hot weather concreting work in accordance with ACI 305R.

5. Do not place concrete when the air temperature exceeds 80 F.

3.07 DEFECTIVE CONCRETE WORK:

A. Porous areas, open or porous construction joints and honeycombed concrete will be considered to indicate that the requirements for mixing, placing and handling have not been complied with and will be sufficient cause for rejection of the members of the structure thus affected.

B. Defective work exposed upon removal of forms shall be entirely removed or repaired within forty-eight hours after forms have been removed.

C. Repaired areas will not be accepted if:

1. The structural requirements have been impaired by reduction in the net section of compression members;

2. The bond between the steel and concrete has been reduced; and

3. The area is not finished to conform in every respect to the texture, contour, and color of the surrounding concrete.

D. If the above requirements are not satisfied, the Engineer may require that the members of unit involved be entirely removed and satisfactorily replaced at no additional expense to the Administration.

3.08 REPAIR OF DEFECTIVE CONCRETE:

A. General: The Engineer will determine the extent and manner of action to be taken for the correction of defective concrete as may be revealed by surface defects or otherwise determined as affecting the durability of the concrete or structure.

B. Repair of Formed Surfaces:

1. As soon as possible after stripping forms, thoroughly clean and fill holes left by form ties, and other temporary inserts, and perform corrective work.

2. Immediately after removing forms, in a manner and by a method accepted by the Engineer in writing prior to start of repair operation, repair and patch defective areas with cement mortar of mix proportions and materials identical to those used in the surrounding concrete. Produce a finish on the patch that is indistinguishable from the finish of the surrounding concrete.

3. Cut-out honeycomb, rock pockets, and voids having a diameter more than 1/2 inch to solid concrete but not shallower than one inch. Make edges of cuts perpendicular to concrete surface. Before placing cement mortar, thoroughly clean, dampen, and brush-coat area to be patched with neat cement grout. Proprietary patching compounds may be used if accepted by the Engineer in writing prior to start of repair operation.

4. Remove imperfect texture, laitance, fins and roughness by rubbing affected areas with concrete block or carborundum stone until smooth and uniform.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces for smoothness and to verify conformance of surface plane to tolerances specified. Correct the low and high areas.

2. Test unformed sloped surfaces for trueness of slope and smoothness, using a template having required slope. Correct high and low areas as specified.

3. Repair finished unformed surfaces that contain defects that adversely affect durability of concrete.

4. Grind high areas in unformed surfaces after concrete has cured sufficiently to permit repairs without damaging adjacent areas.

5. Cut-out low areas in unformed surfaces either during or immediately after completion of surface finishing operations, and replace with fresh concrete. Finish repaired areas to blend into adjacent concrete using specified bonding compounds.

6. Cut-out defective areas, except random cracks and single holes not exceeding one-inch diameter, and replace with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout coating or use concrete bonding agent. Place patching concrete before grout takes initial set. Mix patching concrete of same materials and in same proportions as adjacent concrete. Place, compact, and finish as required to blend with adjacent concrete. Cure in same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over an inch in diameter by the dry-pack method. Groove tops of cracks, cut-out holes to sound concrete, and remove dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply the specified bonding compound. Mix dry-pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and patching. Place dry-pack before grout takes initial set. Compact dry-pack mixture in-place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

8. Obtain approval of the Engineer before performing repair work other than the removal of imperfect texture, filling of pin holes, holes less than 3/4 inch wide, and insert holes. The Engineer will determine whether the defective area is sufficiently imperfect to warrant rejection of the structural unit.

9. Repair methods not specified above may be used, subject to acceptance by Engineer in writing.

PART 4: MEASUREMENT AND PAYMENT

4.01 PORTLAND CEMENT CONCRETE:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 03210

CONCRETE REINFORCEMENT

PART 1 - GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for furnishing and placing reinforcement for concrete structures.

B. Related Work Specified Elsewhere:

1. Section 03300 – Cast-In-Place Concrete

1.02 TOLERANCES:

A. Sheared Length: Plus or minus 1 inch.

B. Depth of Truss Bars: Plus 0, minus 1/2 inch.

C. Stirrups, ties and spirals: Plus or minus 1/2 inch.

D. All Other Bends: Plus or minus 1 inch.

1.03 SUBMITTALS:

A. Shop Drawings and Data (CDRL):

1. Submit for approval bar lists, placement plans and bending diagrams for all reinforcement.

2. Show full description, details, dimensions and locations of each item of concrete reinforcement.

3. Detail reinforcement steel in accordance with the requirements of ACI 318. Show the individual weight of each bar, the total weight of each bar size and the total weight of all bar on the list. Base calculated weights upon theoretical unit weights shown in ASTM A615.

B. Certificates (CDRL):

1. Furnish a certified copy of mill tests on each heat, showing chemical and physical analysis, to the Engineer.

2. Furnish welding certificates as required by AWS D12.1.

1.04 PRODUCT DELIVERY:

A. Deliver reinforcing bars to the fabricator in bundles, limited to one size and length of bar, securely tied and identified with plastic tags in an exposed position identifying the mill, the melt or heat number, and the grade and size of bars.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Reinforcing Steel Bars: ASTM A615, deformed grade 60 unless otherwise indicated.

B. Spiral Reinforcement: ASTM A82.

C. Welded Steel Wire Fabric: ASTM A185, gage, spacing and dimensions as indicated.

D. Accessories: As recommended in ACI 318. Where concrete surfaces will be exposed to public view in the finished structure, use supports with non-staining legs.

2.02 FABRICATION:

A. General: After bar list and bending diagrams have been approved, fabricate each unit of reinforcement to the type, shape, size, grade, and dimensions shown on the approved shop drawing.

B. Cutting and Bending: Perform cutting and bending of reinforcing bars before shipment to site. Bend all bars cold and in a manner that will not injure the material.

PART 3 - EXECUTION

3.01 FORMWORK:

A. Reinforcing steel shall be clean and free of dirt, scale, paint, oil and other foreign matter when placed in the work.

B. Arrange and place reinforcement as shown on the approved bending diagrams and placement plans.

C. Positively secure the reinforcement against displacement during placement of concrete.

D. Wire or clip bars together securely.

E. On formwork for as-cast finish, use spacers which will not reflect in the exposed finish.

3.02 CONCRETE COVER:

A. Cover all reinforcement, including stirrups, to a clear depth, measured from the outside of the bar to the surface of the concrete, as follows:

1. Underground Box Structures:

a.	Invert slab	-	top steel	2 inches
		-	bottom steel	3 inches
b.	Roof slab	-	top steel	2 inches
			bottom steel:	1 1/2 inches
c.	Exterior walls	-	outer face steel	3 inches
			inner face steel:	1 1/2 inches
d.	Center walls:			1 1/2 inches
e.	Beams, girders and columns:			1 1/2 inches
f.	Exposed faces of intermediate Floors, platform slabs, and stairs:			1 inch

2. Retaining Walls:

a.	Footing	-	top steel	2 inches
		-	bottom steel	3 inches
b.	Wall	-	front face steel	2 inches
		-	back face steel	3 inches

3. All Other Underground Structures:

a.	Outer Face Steel:	3 inches
b.	Inner Face Steel:	2 inches
c.	Drainage Slot:	2 inches
d.	Safety Walk:	1 1/2 inches

e. Beams, girders, and columns 1 1/2 inches

f. Other faces covered with floor finishes or ceilings for slabs and stairs: 3/4 inches

4. Above Ground Structures: Follow ACI 318 recommendations.

3.03 CONVEYING OF CONCRETE:

A. Handle concrete from the mixer to the place of final deposit as rapidly as practicable by methods that will prevent segregation, undue drying or temperature rise, or loss of ingredients; and in a manner that will maintain the required quality of concrete.

B. Use conveying equipment of size and design to maintain a continuous flow of concrete at the delivery end and as approved by the Engineer. Do not use conveying equipment with aluminum parts, such as chutes, hoppers, or scrapers, that could come into contact with and contaminate the concrete during conveying.

3.04 SPLICING:

A. Furnish reinforcing bars in full lengths as shown on the Contract Drawings. Splice bars only where indicated on approved shop drawings.

B. Where splices are permitted, use the thermite process or threaded butt splicer with a capacity of not less than 125 percent of minimum yield strength of the bar being spliced. Make splices in accordance with requirements of ACI 318 and AWS D12.1.

C. Inspect all mechanical splices before pouring concrete.

3.05 BAR SUPPORTS AND SPACERS:

A. Furnish reinforcing bars in position by means of approved spacers, chairs or hangers.

B. Support reinforcing steel located in the bottom of slabs resting on earth on precast concrete mortar blocks of the proper size and dimensions to position the steel.

3.06 ELECTRICAL CONTINUITY:

A. Provide electrical continuity between reinforcing steel by welding, at locations indicated, in conformance with AWS D12.1.

PART 4 - MEASUREMENT AND PAYMENT

4.01 CONCRETE REINFORCEMENT:

A. The work required under this Section will not be measured for payment

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for designing, furnishing, erecting, and removing formwork for cast-in-place concrete; placing, curing, protecting, and finishing cast-in-place concrete; and furnishing and placing grout.

B. Related Work Specified Elsewhere:

1. Section 01300 - Submittals

2. Section 03050 - Portland Cement Concrete

3. Section 03210 – Concrete Reinforcement

1.02 DESIGN CRITERIA:

A. Formwork:

1. It is the Contractor's responsibility for design, engineering and construction of formwork.

2. Design formwork for vertical loads and lateral pressures in accordance with American Concrete Institute's "Recommended Practice for Concrete Formwork" ACI 347.

3. Formwork surface materials:

a. General: The forms shall be stiff enough to prevent defections due to loads induced during placement. Use form surface material that will produce surfaces conforming to the following:

i. Concrete exposed to view: Use material that will produce smooth, uniform, blemish-free concrete surfaces.

ii. Concrete concealed from view: Use material that will produce concrete surfaces free of fins and honeycomb.

4. Special Sections: Provide openings, offsets, sinkages, keyways, recesses, moldings, chamfers, blocking, screeds, bulkheads, anchorages, inserts, and other features as required.

   a. Design formwork to be readily removable without impact, shock, or damage to 'green' concrete surfaces and adjacent materials.

B. Allowable Tolerances: Set and maintain concrete forms within tolerance limits stated in American Concrete Institute's "Recommended Practice for Concrete Formwork" ACI 347.

1. Maximum allowable Deviation from dimensions, elevations, slopes and positions, as indicated:

   a. Footings:

      i. Width, depth, and length: No plus limit; minus tolerance not more than 1/2 inch.

      ii. Misplacement or eccentricity: 2 inches.

      iii. Elevation of top: Plus or minus 1/4 inch.

   b. Top of base courses to receive No. 5 finish: adjust to provide finish surface tolerance.

   c. Top of all other base courses: Plus 0, minus 3/4 inch from course profile elevation at every point and if slope is indicated, plus or minus 1/4 inch in 10 feet.

   d. Top of track slab finish course: Plus or minus 1/4 inch from finish profile grade at every point and plus or minus 1/8 inch in 10 feet for longitudinal and transverse slope.

   e. Safety walks: Plus or minus 1/4 inch vertical and horizontal.

   f. Top elevation of slabs not otherwise specified: Plus or minus 1/2 inch at each point; and if slope is indicated, plus or minus 1/8 inch in 10 feet.

   g. Top elevation of columns, piers: As necessary to join other surfaces and not more than plus or minus 1/4 inch.

h. Plumb of columns, piers, and joints not exposed to view in public areas of finished structure: 1/4 inch in ten feet, not exceeding one inch total.

i. Plumb of columns, piers, vertical joints and grooves and other prominent vertical lines exposed to view in public areas of finished structure: 1/4 inch in 20 feet, not exceeding 1/2 total.

j. Cross sectional dimension of columns, and slabs: Plus or minus 1/4 inch, except increase thickness of slabs on grade necessary to achieve specified top elevations.

C. Referenced Standards:

1. American Plywood Association:

a. APA Grade - Trademarks.

2. U.S. Department of Commerce Product Standards:

a. PS-1-74 for Construction and Industrial Plywood.

3. Western Wood Products Association:

a. WWPA Catalog "A" Product Use Manual.

4. American Concrete Institute:ACI 301, Specifications for Structural Concrete for Buildings.

a. ACI 305R, Hot Weather Concreting.

b. ACI 306R, Cold Weather Concreting.

c. ACI 308, Standard Practice for Curing Concrete.

d. ACI 318, Building Code Requirements for Reinforced Concrete.

5. American Society for Testing and Materials (ASTM):

a. ASTM A36/A36M, Specification for Carbon Structural Steel.

b. ASTM A153, Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

c. ASTM A653/A653M, Specification for Steel Sheet, Zinc-ated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed)

-Dip Process.

d. ASTM B653, Specification for Seamless and Welded Zirconium and Zirconium Alloy Welding Fittings. ASTM C31, Practice for Making and Curing Concrete Test Specimens in the Field.

e. ASTM C156, Test Method for Water Retention by Concrete Curing Materials.

f. ASTM C171, Specification for Sheet Materials for Curing Concrete.

g. ASTM C191, Test Method for Time of Setting of Hydraulic Cement by Vicat Needle.

h. ASTM C309, Specification for Liquid Membrane - Forming Compounds for Curing Concrete.

l. ASTM C596, Test Method for Drying Shrinkage of Mortar Containing Portland Cement.

m. ASTM C827, Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures.

n. ASTM C1019, Test Method for Sampling and Testing Grout..

6. American Association of State Highway and Transportation Officials (AASHTO):

a. AASHTO M182, Burlap Cloth made from Jute or Kenaf.

7. State Highway Administration Standard Specifications for Construction and Materials: Section 414, 901, 902 and 915.

D. Testing Laboratory

1. Utilize the services of the Regional State Highway Administration testing laboratory to perform the testing in accordance with requirements of the Specifications. Submit certified results of all tests performed, in accordance with the General Requirements.

2. Samples of grout as placed will be subjected to laboratory tests.

3. All materials incorporated in the work shall conform to approved samples.

1.03 SUBMITTALS:

A. In accordance with Section 01300, submit the following:

1. Working Drawings (CDRL):

a. Include details of form types, methods of form construction and erection, design computations and location of form joints and form ties, construction joints, scheduled date and rate of placing, and mix designations.

2. Samples (CDRL):

a. Snap-off form ties: Two samples.

b. Form and bond breaker oils: Two samples each.

c. Membrane-forming curing compound: Two, one pint each.

3. Certification (CDRL):

a. Manufacturer's certificates.

b. For early form removal: certified test reports of specified concrete tests.

4. Documentation (CDRL):

a. Calculations: Early form removal calculations as specified certified by a Professional Engineer registered in the State of Maryland. Submit in advance of form removal.

b. Quality control reports. Submit as specified after installation

5. Location of finished work (CDRL):

a. Report the location in the finished work, start of placement and finish times, finish slumps for each batch of concrete placed.

6. Test Reports (CDRL):

a. Prior to production of grout, submit for approval a design mix indicating materials proportions and results of compressive strength and slump tests as specified herein. Materials to be used in the proposed design mix shall be as specified herein.

1.04 JOB CONDITIONS:

A. Formwork Protection:

1. Protect formwork materials before, during and after erection to insure acceptable finished concrete work. Also protect in-place materials and other operations of work in connection with concrete pours.

2. In event of damage to erected forms; make necessary repairs or replacements prior to concrete pours at no expense to the Owner.

3. Allow sufficient time, as determined by the Engineer from approved schedule, between erection of forms and placing of concrete for the various trades to properly install their work.

4. Do not apply external or superimposed loads, lateral or vertical, to structure until adequate shoring and bracing has been placed or until such concrete has developed specified 28-day compressive strength and a minimum age of 14 days.

B. The Contractor shall not interrupt the existing light rail service during any phase of construction. Rail service must be maintained and no closures will be permitted and no equipment will be permitted within a ten-foot envelope from the live catenary wire as specified elsewhere in these specifications. Furthermore, cranes and other equipment shall be oriented such that a failure of the equipment shall not foul the adjacent track, adjacent CSXT Track or catenary.

C. Stay-in-Place forms are not permitted.

D. Grout:

1. Protect against high and low temperatures and bad weather in accordance with ACI standards for placement of concrete.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Prevent moisture damage and contamination of materials.

B. Store materials in undamaged condition with seals and labels intact as packaged by the manufacturer.

PART 2: PRODUCTS

2.01 MATERIALS:

A. Lumber:

1. Form framing, sheathing and shoring shall conform to WWPA Catalog A.

2. Use lumber free of material defects that would deform the finished concrete product.

B. Plywood:

1. Form Sheathing and Panels: Not less than 5/8 inch thick Exterior Type B-B Plywood, Class I and II, EXT-APA conforming to U.S. Product Standard PS-1-74.

2. Use Class II only on surfaces not exposed to view.

C. Steel:

1. Sheet: Commercial Grade, not thinner than 16 gauge.

2. Structural Shapes: ASTM A36.

3. Metal forms of a pre-engineered standard design, but conforming to the concrete sections indicated on the Contract Drawings, may be used in lieu of wood forms.

D. Form Ties:

1. Provide factory-fabricated, adjustable-length, removable or snap-off metal form ties conforming to ACI 347.

2. Use snap-off metal ties with ends that break at least 1-1/2 inches from the face of the wall.

3. Removable ties that leave holes larger than 7/8 inches are not permitted.

4. Form ties fabricated on the project site and wire ties or flat bands are not acceptable.

5. Wood spacers are not permitted within the pour.

E. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds.

F. Chamfer Strips: Triangular fillets all of which shall be milled from clear, straight-grain pine, surfaced each side, or all of which shall be extruded vinyl type with or without nailing flange unless otherwise indicated.

G. Leakage Control Materials:

1. General: Products which are capable of producing flush, watertight and non-absorbent surfaces and joints and are compatible with type of forming material and concrete ingredients used.

2. Caulking Compound: One of the following products or approved equal:

a. Clear silicone type similar to Series 1200 Construction Caulking as produced by General Electric - Silicone Products Division.

b. Dow Corning 781 Caulking as produced by DOW Corning Adhesives.

3. Tapes: One of the following products or approved equal:

a. Seam-Strip by Preco Industries.

b. Tesa Formstik Tape number 720 by United Mineral and Chemical.

c. Form Film Tapes: Polypropylene plastic tape treated with waterproof adhesive for joint conditions.

H. Curing Materials, Sheet Form: Use curing materials that will not stain or affect concrete finish or lessen the concrete strength and comply with the following requirements:

1. Burlap: Use materials conforming to AASHTO M182.

2. Sheet Materials: Use materials conforming to ASTM C171.

I. Liquid Curing Compounds:

1. Liquid Membrane - Forming Compounds: For all exterior concrete surfaces and interior concrete floor surfaces where a finish material will be applied over the concrete, the following shall apply:

a. Use material meeting the requirements of ASTM C309, Type 1, free of wax or other adhesive bond breaking ingredients, and manufactured from an acrylic-copolymer base compound:

J. Liquid Curing and Sealing Material: Except as specified in Article 2.01.C., above, for all new, exposed interior concrete floor surfaces and all interior concrete floor surfaces receiving mastic applied adhesive, and exterior slabs, sidewalks, curbs, architectural concrete and any concrete where total resistance to yellowing and blushing from ultra-violet light and water exposure is required, the following shall apply:

1. Liquid Membrane-Forming and Sealing Compounds: Use curing and sealing compounds meeting the requirements of ASTM C309, Type 1, free of wax and manufactured from chlorinated rubber base material with a minimum of 18 percent solids contents, with dust-proofing and sealing qualities.

K. Grout:

1. Water Potable quality, free from deleterious amounts of acids, alkalis, and organic substances.

L. Non-Shrink Non-Metallic Grout: Factory premixed material containing no corrosive irons, aluminums, chemicals or gypsums.

1. Grouts containing water reducers, accelerators, or fluidifiers shall have no drying shrinkage greater than the equivalent sand cement and water mix as tested per ASTM C596.

2. Grout shall be nonshrink before initial set and show no expansion after set as tested per ASTM C827.

3. Initial set of grout not less than 60 minutes per ASTM C191 Test.

4. Use Type I (Normal) cement in grout formulation.

5. Minimum compressive strength: 4,500 psi.

6. Use ready-mix type requiring only the addition of water. Do not add other materials. Water requirement proportions shall conform to manufacturer's specifications for the desired mix consistency.

M. Neat Cement:

1. Portland Cement: ASTM C150 Type I.

2. Water: As specified above.

3. Mixture of portland cement and water in the same proportions used in cast-in-place 4500 psi concrete with fine aggregate and coarse aggregate omitted.

2.02 SHOP-FABRICATED FORMS:

A. Steel forms: Use stock material which is clean, smooth, and free from warps, bends, kinks, rust, cracks, and matter which could stain concrete. Reinforce outward facing surfaces in a manner that will prevent warpage and deformation during concrete placement.

PART 3: EXECUTION

3.01 INSPECTION:

A. Prior to placement of concrete, inspect forms for cleanliness and accuracy of alignment. Engineer shall be given 48 hours after placement of reinforcement to inspect forms before concrete is poured.

B. No frost on forms when placing concrete.

C. No ponding of water prior to placing of concrete.

3.02 PREPARATION:

A. Forms: Apply form coatings in accordance with manufacturer's specifications.

1. Coat form contact surfaces with form release agent compound before reinforcement is placed. Do not allow excess form release agent material to accumulate in the forms or to come into contact with surfaces that are to be bonded to fresh concrete, such as concrete reinforcement and embedded items. Apply form release agent in compliance with manufacturer's instructions.

2. Coat steel forms with non-staining, rust-preventive form oil or otherwise protect against rusting. Do not use rust-stained steel surfaces for contact with concrete.

B. Do not allow excess form coating material to accumulate in the forms.

C. Do not allow form coatings to come in contact with construction joints or reinforcing steel.

D. Grout: Forming

1. Use forming procedures that allow proper and complete placement of grout.

2. Anchor support elements so no movement is possible.

3. Remove supports only after grout has hardened.

4. Pre-treat wood forms with forming oils that may absorb moisture.

E. Preparation of Surface:

1. Non-shrink Grout: Prepare in accordance with manufacturer's printed instructions.

F. Mixing:

1. Equipment: Use power operated mechanical mixer.

G. Time:

1. Neat Cement: In accordance with requirements for cast-in-place concrete.

2. Non-Shrink Grout: In accordance with manufacturer's printed instructions.

3.03 MIXES:

A. Portland Cement Concrete: Section 03050.

B. Water: Potable quality, free from deleterious amounts of acids, alkalis, and organic substances.

C. Structural Members:

1. Prepare grout composed of portland cement, sand and water.

2. Use portland cement grout under bearing plates, in recesses, holes or surfaces under structural members and at other locations shown on drawing.

3. Do not use staining ingredients in grout exposed to view.

4. Use proportions of two parts sand and one part cement measured by volume and containing only enough water to permit placing and compact packing. Mix grout approximately 45 minutes in advance of use.

3.04 ERECTION:

A. Construct forms in accordance with ACI 347 to required dimensions, plumb, straight and mortar tight, and make all joints and seams mortar-tight. Securely brace and shore forms as shown on approved working drawings to prevent displacement and to safely support imposed concrete load.

B. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in the finished slab surface.

C. Wet forms sufficiently to prevent joints in wood forms from opening prior to concrete pour.

D. Cutting form ties back from the face of the concrete is not permitted.

E. Observe formwork continuously while concrete is being placed to see there are no deviations from desired elevation, alignment, plumb and camber. If, during casting, weakness develops and the formwork shows settlement, deflection or distortion, stop the work, remove improperly cast concrete, and reconstruct the formwork to perform properly.

F. Joints:

1. Unless otherwise directed, make contraction, expansion and construction joints only where shown.

2. Form keyways as shown.

3. Install premolded joint filler at locations shown. Extend filler from bottom of concrete up flush to finish concrete surface or hold down below finish surface as shown.

4. Make splices in premolded filler in manner to preclude penetration of concrete between joint faces.

3.05 FORM REMOVAL:

A. Remove forms in accordance with ACI 347 recommendations without damage to concrete and in a manner to insure complete safety to the structure.

B. Maintain falsework and forms in place under pier caps, slabs, girders, and brackets in place for 5 days (min.) after placing the final portion of the section involved, after which they may be removed provided the concrete has attained a minimum of 90 percent of specified design strength and is being cured as specified.

C. Maintain forms for outside faces of pier caps, sides of girders, and other vertical faces not sustaining loads, in place for 12 hours after completing placement of concrete. Then, remove forms, provided the concrete has hardened enough to preclude damage from form removal. Except, during cold weather curing, keep forms in place for 5 days, unless otherwise permitted, in writing, by the Engineer.

D. At construction joints, keep bulkheads in place 12 hours after placing concrete. Then, remove bulkheads provided the concrete has hardened enough to preclude damage resulting from removal of the bulkheads. Except, during cold weather curing, keep bulkheads in place for 48 hours and keep the concrete moist at all times.

E. Remove forms and falsework for listed and non-listed members only after:

1. Concrete strength attained prior to form removal has been determined from tests of cylinders cured adjacent to and under same conditions as placed concrete.

2. Three test cylinders have been tested by an independent testing laboratory approved by the Engineer.

F. Hammer-pack holes left by tie rods with stiff mortar of the same material as, but somewhat leaner than, that in the concrete. Render the patch inconspicuous.

3.06 RE-USE OF FORMS:

A. Forms for re-use shall meet new form requirements with respect to affect on poured concrete appearance and structural stability.

B. Re-use of forms shall in no way delay or change the concrete pour schedule as compared to the schedule obtainable if all forms were new (in the case of

wood forms) or if the total required forms were available (in the case of metal forms).

3.07 PLACEMENT:

A. Non-Shrink Non-Metallic Grout: Perform grout placement in accordance with the recommendations of ACI and the manufacturer's published specifications for mixing and placing. Place non-shrink non-metallic grout only where indicated on the Contract Drawings.

B. Neat Cement: Perform grout placement in accordance with the requirements of cast-in-place concrete.

3.08 CONCRETE FINISHING, DEFECTIVE CONCRETE WORK:

A. Porous areas, open construction joints and honeycombed concrete will be considered to indicate that the requirements for mixing, placing and handling have not been complied with and will be sufficient cause for rejection of the members of the structure thus affected.

B. Defective work exposed upon removal of forms shall be entirely removed or repaired within forty-eight hours after forms have been removed.

C. Repaired areas will not be accepted if:

1. The structural requirements have been impaired by reduction in the net section of compression members;

2. The bond between the steel and concrete has been reduced; and

3. The area is not finished to conform in every respect to the texture, contour, and color of the surrounding concrete.

D. If the above requirements are not satisfied, the Engineer may require that the members of unit involved be entirely removed and satisfactorily replaced at no additional expense to the Administration.

3.09 REPAIR OF DEFECTIVE CONCRETE:

A. General: The Engineer will determine the extent and manner of action to be taken for the correction of defective concrete as may be revealed by surface defects or otherwise determined as affecting the durability of the concrete or structure.

B. Repair of Formed Surfaces:

1. As soon as possible after stripping forms, thoroughly clean and fill holes left by form ties, and other temporary inserts, and perform corrective work.

2. Immediately after removing forms, in a manner and by a method accepted by the Engineer in writing prior to start of repair operation, repair and patch defective areas with cement mortar of mix proportions and materials identical to those used in the surrounding concrete. Produce a finish on the patch that is indistinguishable from the finish of the surrounding concrete.

3. Cut-out honeycomb, rock pockets, and voids having a diameter more than 1/2 inch to solid concrete but not shallower than one inch. Make edges of cuts perpendicular to concrete surface. Before placing cement mortar, thoroughly clean, dampen, and brush-coat area to be patched with neat cement grout. Proprietary patching compounds may be used if accepted by the Engineer in writing prior to start of repair operation.

4. Remove imperfect texture, laitance, fins and roughness by rubbing affected areas with concrete block or carborundum stone until smooth and uniform.

C. Repair of Unformed Surfaces:

1. Test unformed surfaces for smoothness and to verify conformance of surface plane to tolerances specified. Correct all low and high areas.

2. Test unformed sloped surfaces for trueness of slope and smoothness, using a template having required slope. Correct high and low areas as specified.

3. Repair finished unformed surfaces that contain defects that adversely affect durability of concrete.

4. Grind high areas in unformed surfaces after concrete has cured sufficiently to permit repairs without damaging adjacent areas.

5. Cut-out low areas in unformed surfaces either during or immediately after completion of surface finishing operations, and replace with fresh concrete. Finish repaired areas to blend into adjacent concrete using specified bonding compounds.

6. Cut-out defective areas, except random cracks and single holes not exceeding one-inch diameter, and replace with fresh concrete. Remove defective areas to sound concrete with clean, square cuts,

and expose reinforcing steel with at least 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and brush with neat cement grout coating or use concrete bonding agent. Place patching concrete before grout takes initial set. Mix patching concrete of same materials and in same proportions as adjacent concrete. Place, compact, and finish as required to blend with adjacent concrete. Cure in same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over an inch in diameter by the dry-pack method. Groove tops of cracks, cut-out holes to sound concrete, and remove dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply the specified bonding compound. Mix dry-pack, consisting of one part portland cement to 2 1/2 parts fine aggregate passing No. 16 sieve, using only enough water for handling and patching. Place dry-pack before grout takes initial set. Compact dry-pack mixture in-place and finish to match adjacent concrete. Keep patched areas continuously moist for not less than 72 hours.

8. Obtain approval of the Engineer before performing repair work other than the removal of imperfect texture, filling of pin holes, holes less than 3/4 inch wide, and insert holes. The Engineer will determine whether the defective area is sufficiently imperfect to warrant rejection of the structural unit.

9. Repair methods not specified above may be used, subject to acceptance by Engineer in writing.

3.10 FINISHING:

A. Finishes: Finish exposed concrete surfaces true and even, free from open or rough areas, depressions or projections. Bring concrete up in vertical pours to the required elevation, strike-off with a straight edge and float-finish.

1. Spade Finish: Obtained by forcing a flat spade or similar device, down adjacent to the form and pulling the top of the spade away from the form to bring mortar to the surface next to the forms. After forms are removed satisfactorily, correct concrete surface irregularities.

2. Floated Finish: After concrete has been placed, consolidated, struck off and leveled, do not work further until ready for floating. Begin floating when water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after first floating, check planeness of surface with a 10-ft. straightedge applied at not less than two different angles. Cut down high spots and fill low spots during this procedure to achieve a tolerance of 1/8” as

determined by a 10-ft. straightedge placed anywhere on the slab in any direction. Following straightedge checking, refloat slab immediately to a uniform sandy texture.

3. Smooth Rubbed Finish: Obtained by rubbing a "Spade Finished" vertical surface not later than one day after form removal. Wet surface and rub with carborundum brick or other abrasive until uniform color and textures are produced. Do not use cement grout other than the cement paste drawn from the concrete itself by the rubbing process.

4. Flat Trowel Finish: Obtained by hand or power troweling a "Floated Finish" with a single troweling. This troweling (first after power floating) shall produce a smooth surface which is relatively free of defects but which may still show some trowel marks.

5. Fine Trowel Finish: Obtained by performing additional hand and power troweling to a "Flat Trowel Finish". Perform an additional troweling by hand or power trowel after the surface has hardened sufficiently. Perform the final troweling when a ringing sound is produced as the trowel is moved over the surface. Thoroughly consolidate surface by hand trowel operations.

6. Broom Finish: Immediately after concrete has received a "Floated Finish", give surface a coarse transverse scored texture by drawing a broom across the surface in the direction of the paved slope. Texture shall be as approved by the Engineer.

B. Application for Finishes:

1. Spade Finish:

a. Surfaces not exposed to general view.

b. Surfaces to be rubbed.

3. Smooth Rubbed Finish:

a. Exposed surfaces of structures, including concrete piers down to one foot below the finished grade elevation.

4. Steel Trowel Finish (includes both flat trowel and fine trowel finish):

a. Bearing pads.

5. Broom Finish:

a. Deck surfaces.

3.11 CURING AND PROTECTION:

A. General: Immediately after placement, protect concrete from premature drying, excessive hot or cold temperatures and mechanical injury. Curing shall be by water, liquid membrane-forming compound, or liquid membrane-forming and sealing compound methods in accordance with ACI 308. Cure concrete continuously for a minimum of 7 days at ambient temperature above 40 degrees F.

B. Hot Weather Curing: See Hot Weather Concreting in Structural Concrete, Section 03050.

C. Cold Weather Curing: See Cold Weather Concreting in Structural Concrete, Section 03050.

D. Application Rate of Liquid Membrane-Forming Compounds and Liquid Membrane-Forming and Sealing Compounds: Compound shall restrict the loss of water to not more than 0.055 g/cm^2 of surface in 72 hours when tested in accordance with ASTM C156 at the coverage rate recommended by the manufacturer.

1. Submit letter from manufacturer stating coverage rate of liquid membrane-forming compound and liquid membrane-forming and sealing compound to meet this restriction in loss of water.

3.12 PROTECTION FROM AND REMOVAL OF STAINS:

A. Protect the concrete structure from rust staining by structural steel members and from other substances during the work.

B. If staining does occur, remove stains and restore the concrete to its original color.

PART 4: MEASUREMENT AND PAYMENT

4.01 CAST-IN-PLACE CONCRETE:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 07270

FIRESTOPPING

PART 1: GENERAL

1.01 CONDITIONS & REQUIREMENTS:

A. Refer to the General Conditions, Special Conditions, and any other conditions or requirements referenced elsewhere.

1.02 DESCRIPTION:

A. Firestopping of voids and openings in fire and smoke assemblies, walls, and floors, and perimeters; unless firestopping is specifically required under other sections.

B. Provide where applicable, including but not limited to:

1. At floor level in stud walls **that** bypass floors.
2. At top of wall below structure.
3. At building expansion joints.
4. At openings, regardless of size, which are left in fire assemblies.

1.03 QUALITY ASSURANCE:

A. Perform testing in accordance with the following:

1. ASTM-E814
2. ASTM-E119
3. Standard 1479

1.04 SUBMITTALS:

A. Product data (CDRL):

1. UL report with illustration of system and system number.
2. Fire and temperature rating data.
3. Certification that components are asbestos free.

FIRESTOPPING

PART 2: PRODUCTS

2.01 ACCEPTABLE:

A. Forming Material:

1. Established standard: Any manufacture UL listed for system used See “Building Material Directory”

2. Fill, void or cavity materials: Any manufacture UL listed for system used See “Building Material Directory”

3. Firestopping Sealant: Any manufacture UL listed for system used See “Building Material Directory”

4. Perimeter fire containment systems: Any manufacture UL listed for system used See “Building Material Directory”

2.02 MATERIALS:

A. Forming material:

1. Inorganic mineral fibers and binders into semi-rigid blankets.

2. ASTM-E84 flame spread: Maximum 25.

3. ASTM-El19 and ASTM-E814 tested as component of assembly.

4. Thickness and density as required to maintain fire rating of assembly.

5. Retainer: Minimum of 20 GA, G60 galvanized steel.

B. UL listed as component of “Through-Penetration Firestop System” for the following use.

1. Fill, void or cavity materials

2. Forming materials

3. Firestopping sealants

4. Firestop sealer

FIRESTOPPING

PART 3: EXECUTION

3.01 INSTALLATION – OR PACKING OF MATERIALS:

A. Install all fire stopping in accordance with manufacturer's instructions, to maintain fire separations per UL listing.

3.02 INSTALLATION-FILL, OR CAVITY MATERIALS:

A. Install all fire stopping in accordance with manufacturer's instructions, to maintain fire separations per UL listing.

3.03 INSTALLATION-SEALANT OR SEALER:

A. Install all fire stopping in accordance with manufacturer's instructions, to maintain fire separations per UL listing.

3.04 INSTALLATION-OTHER COMPONENTS

A. Install all fire stopping in accordance with manufacturer's instructions, to maintain fire separations per UL listing.

3.05 RESPONSIBILITY

A. Contractor’s is responsible to select a system, or combination of systems which. when installed, will maintain required fire separation between building elements.

B. System must provide fire (F) and temperature (T) rating as required by applicable codes.

C. Contractor’s option:

1. Large openings may be closed using the same type of construction as adjacent assembly to maintain fire separations.

2. Final closure between assembly and penetrating element must be accomplished using systems specified. patching and repair of firestopping systems damaged by other trades.

PART 4: MEASUREMENT AND PAYMENT

4.01 FIRESTOPPING:

A. Firestopping will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 07920

SEALANTS AND CAULKING

PART 1: GENERAL

1.01 CONDITIONS &REQUIREMENTS

A. Refer to the General Conditions, Special Conditions, and any other conditions or requirements referenced elsewhere.

1.02 DESCRIPTION

A. Furnish and install all sealants and caulking for non-fire rated conditions.

1. Firestopping and sealants for rated conditions: Section 07270.

1.03 QUALITY ASSURANCE

A. Use only workmen skilled and trained in the techniques of sealants and caulking and who are completely familiar with the published recommendations of the manufactures of the manufacturers of sealants and caulking being used.

B. Installer qualifications: Use only experienced installers who have completed at least 5 similar projects comparable in size and scope of work in the last 5 years in the area of the project.

C. Maintain complete manufacturer's installation directions for all products at the job site throughout installation.

D. Furnish products to comply with industry standards and UL listing.

1.04 SUBMITTALS

A. Submit product data for each use (CDRL).

B. Submit color sample for selection and/or to verify custom colors (CDRL).

PART 2: PRODUCTS AND MATERIALS

2.01 ACCEPTABLE MANUFACTURERS

A. All manufactures are acceptable as long as they are UL listed for the intended application. It's the contractors responsible to provide the Engineer with this assurance in writing from the manufacture.

PART 3: EXECUTION

3.01 INSTALLATION

A. Clean all surfaces thoroughly and carefully. Apply primer to those which sealant manufacturer recommends be primed. Take care that adjacent surfaces are not smeared. Use tape where necessary for protection.

B. Use one-piece backer rod that is ⅓ to ½ wider than width of joint so sufficient pressure is exerted by filler to provide substantial resistance to displacement.

C. Install joint backer rod for backup to control limits for receiving sealant as recommended by sealant manufacturer. Use blunt tools. Remove and replace all broken and punctured rods.

D. If joint is too shallow for use of hacker rod, apply bond breaker to back of joint as recommended by sealant manufacturer. If bond breaker is used, apply it carefully to avoid prevention of sealant bond to sides of joints.

E. Use guns where possible to insure penetration and density. Finish joint densely and completely filled, producing a smooth surface.

F. Do no installation during freezing weather or beyond temperature limits set by manufacturer, or against wet or damp materials. Protect installed sealant from dust and dirt.

3.02 APPLICATION

A. At exterior locations and at interior joint subject to movement, except floors and areas subject to moisture: Polyurethane or silicone sealant, but not both materials for exterior locations.

B. At interior and exterior floor expansion joints: Floor expansion joint sealant.

C. At interior and exterior floors where epoxy is shown: Semi-rigid control joint epoxy sealant.

D. At interior locations subject to moisture: Sanitary sealant.

E. At interior locations not subject to movement, unless noted otherwise: Caulking.

F. At muffler penetrations: High temperature resistant caulking.

3.03 CLEANUP

A. Clean off excess materials from joints and surrounding surfaces. Remove discarded cartridges and other debris.

PART 4: MEASUREMENT AND PAYMENT

4.01 SEALANTS AND CAULKING:

A. Sealants and Caulking will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 15140

SUPPORTS, ANCHORS, AND SEALS

PART 1: GENERAL

1.01 DESCRIPTION:

A. Refer to the General Conditions, Special Conditions, and any other conditions or requirements referenced elsewhere.

B. This Section specifies the basic requirements for providing supports, anchors and seals which are an integral part of piping, ductwork and electrical & mechanical systems equipment. These components include, but are not limited to Sch. 40 steel piping, ductwork,vibration isolated pipping, plumbing and fire protection piping installed as an integral part of electrical, fire protection and mechanical systems equipment.

1.02 SUBMITTALS:

A. During PDR and FDR Phase, submit product data and design for supports, anchors and seals which are an integral part of piping, ductwork and electrical & mechanical systems, as required by the individual equipment specification Sections (CDRL).

1.03 QUALITY ASSURANCE:

A. Suspended piping (mechanical, plumbing, fire protection), electrical conduit and equipment shall be attached to the structure, supported by, and seismically braced per the most current revision of one of the following:

1. National Uniform Seismic Installation Guidelines, which shall be considered applicable for the following:

   a. Anchorage, to concrete (vertical support, wall floor connections).

   b. Anchorage, to concrete (seismic brace connections).

   c. Anchorage, to steel (seismic connections).

   d. Piping, sch. 40 steel, uninsulated (single hangerltrapeze).

   e. Piping, sch. 40 steel, insulated (single hangerltrapeze). M copper, uninsulated (single hangerltrapeze). M copper; insulated (single hangerltrapeze). protection (single hangerltrapeze). round (single hangerltrapeze).

f. Ductwork, oval (trapeze).

Ductwork, square rectangle (double hangerltrapeze).

g. Equipment, (trapeze).

h. Vibration Isolated Piping, sch. 40 steel, uninsulated (single hangerltrapeze).

i. Vibration Isolated Piping, sch. 40 steel, insulated (single hangerltrapeze).

j. Vibration Isolated Piping, plumbing types K, L M copper, uninsulated (single hangerltrapeze).

k. Vibration Isolated Piping, plumbing types K, L & M copper, insulated (single hangerltrapeze).

l. Vibration Isolated Equipment, (trapeze).

m. Piping, plumbing types K, L & M coppe.

n. Piping, plumbing types K, L & M coppe.

o. Piping, fire protection (single hangerltrapeze).

p. Piping, cast iron (single hangerltrapeze).

q. Ductwork, round (single hangerltrapeze)

2. SMACNA – (Seismic Restraint Manual) which shall be considered applicable for the following:

a. Anchorage, to concrete (seismic brace connections).

b. Anchorage, to steel (seismic brace connections).

c. Piping, sch. 40 steel, uninsulated (single hangerltrapeze).

d. Dnctwork, round (single hangerltrapeze).

e. Ductwork, square rectangle (double hangerltrapeze).

B. Do not **mix** seismic bracing designs within a given new system design.

C. Fire protection piping shall be braced, supported and attached to the structure according to NUSIG.

D. All conditions which involve thermal building expansion and contraction shall be taken in consideration and identified in the as-built documents.

E. Seismic bracing, support and anchorage to the of all conditions which involve thermal building expansion and contraction shall be engineered and built by the applicable system SUBCONTRACTOR. When applicable NUSIG SMACNA seismic bracing, support anchorage details shall be used. Review these details with CONTRACTOR.

F. SUBCONTRACTOR shall submit during PDR and FDR Phase, prior to installation, seismic brace seismic brace connection to system seismic brace connection to and seismic brace spacing or lay-out details.

G. All connections to the structure shall be sized according to actual applied load plus any seismic vertical component increase. Do not size connection to the structure according to threaded hanger rod size.

H. SUBCONTRACTOR shall submit, prior to installation, data identifying the various support to structure connections and seismic brace structure connections. Submittal data shall identify the following:

1. Location of connections.

2. Numerical identification of maximum allowable design value of connecting method.

3. Numerical value of applied load or reaction.

4. Type of connection (vertical support, vertical support with seismic brace, seismic brace).

5. Seismic brace reaction type (tension compression).

6. Detailed drawing (listing all related components) of method of connections.

I. NUSIG shall be considered applicable for seismic design force application up to (1.0 SMACNA shall he considered applicable for seismic design force application up to (0.5).

J. Seismic design force applications greater than those noted of NUSIG or SMACNA, shall be engineered by the and submitted prior to installation.

K. Applications listed within NUSIG or SMACNA that are not usable within a given structure, shall be resolved through engineered adaptations or alteration. Whenever possible these adaptations or alterations shall use NUSIG or SMACNA approved components, so as to maintain compliance and uniformity with NUSIG or engineering standards and design principles.

In all cases, and prior to installation, these adaptations or alterations shall be engineered in accordance with standard engineering practices by a qualified, registered structural engineer, and shall be submitted to CONTRACTOR for review and approval.

PART 2: PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS:

A. Waterproof Sleeves:

1. Established standard:

B. Hangers:

1. Established standard:

a. Any manufacturer who can verify compliance with the NUSIG standards.

C. Strut-Channel Framing:

1. Established standard:

a. Any manufacturer who can verify compliance with the NUSIG standards.

D. Anchors-Drill In:

1. Established standard:

a. Any manufacturer within the NUSIG standards.

E. Seismic Expansion Compensators:

1. Established standard:

a. Adsco.

2. Other acceptable manufacturers: Products established standard manufacturer's products.

a. Hyspan.

b. Flexonics.

F. Sleeves:

1. Thunderline.

   a. Link-Seal

G. Other acceptable manufacturers:

1. Calpico.

2. Sealing Linx.

2.02 ANCHORS, INSERTS AND FASTENERS:

A. All anchors and inserts shall be installed according to the NUSIG standards.

B. Do not use any anchor or insert in concrete which does not have a signed structurally engineered design value based on its installed application.

C. Do not use powder driven and power driven (Shoot-In) fasteners, expansion nails or friction spring clips.

D. All over-head concrete anchors or inserts shall be selected from listings NUSIG-AA and shall have maximum allowable design tension or shear values no greater than those listed within NUSIG-AA or equal.

E. All anchors, inserts or connections to the structure shall be submitted to the CONTRACTOR for approval.

F. Box type inserts which allow movements for horizontal adjustment shall not be allowed, unless engineered solution is provided to assure positive captive positioning and securement of load bearing attachment.

G. All combined tension and anchor or insert attachments shall be engineered.

H. All unusable non-compliance anchors or inserts, shall be cut-off flush with the concrete or removed.

I. Job site torque and/or load or pull testing shall not be allowed as justification for use of non-compliance anchors or inserts.

J. Torque testing of anchors shall be allowed to verify compliance of anchor installation, however, torque testing shall not justify usability of anchor. Only load or pull testing shall be allowed to justify usability of anchors. Failure of torque shall constitute failure of anchor.

K. 50 percent of anchors installed in concrete shall be tested in alternate groups, upon failure of an anchor, the next 20 consecutive anchors must pass, before 50 percent alternate pup testing can resume.

L. If anchor failures are due to SUBCONTRACTOR retesting of failed anchors as well as consecutive anchor testing to SUBCONTRACTOR'S ability to properly install anchors will be at the SUBCONTRACTOR'S expense.

M. All items attached to or supported from structural or miscellaneous steel shall have a positive assembly and shall be through bolted, welded or clamped to the

N. All clamps shall he constructed of malleable or steel and shall include a retaining strap or J-hook.

2.03 PIPE HANGERS AND SUPPORTS FOR NON-SEISMIC BRACING APPLICATION:

A. Hangers for Steel or Copper Pipe, All Sizes: An adjustable wrought steel clevis, copper-plated for copper piping.

B. Hangers for Cold Insulated Steel or Copper Pipe, All Sizes: An adjustable wrought steel clevis, sized to suit 360 degree high-density insulation insert.

C. High Density Insulation

1. For pipes 2-112 inches and larger use 360 degree calcium silicate (waterproofed for chilled water) inserts having a 360 degree sheet metal protective sleeve. Thickness of insert shall match pipe covering (insulation) thickness. Inserts shall have an independent lab certified break, crack crush strength equal to or greater than 5 times the applied load. Do not use inserts at seismic brace connection locations without prior written approval from the CONTRACTOR. Do not connect seismic bracing to inserts without prior written approval from the CONTRACTOR. Submit copies of insert manufacturers independent lab test reports. Replace all cracked, damaged and/or non-compliance inserts at no additional cost.

D. Multiple or Trapeze Hangers: Steel channels or angles with welded spacers and hanger rods, sized to support load.

E. Wall Support for Pipe Sizes to 3 inches: Cast iron hooks.

F. Wall Support for Pipe, Sizes 4 inches and Larger: Welded steel bracket and wrought steel clamp; adjustable steel yoke and cast iron roll for hot pipe, sizes 5 inches and larger.

G. Vertical Support: Steel riser clamp.

H. Design hangers to impede disengagement by movement of supported pipe.

I. Provide copper-plated hangers and supports for copper piping or provide isolator between hanger or support and piping.

J. Provide angles or channels to span joists and distribute load.

K. Do not use wire for either temporary or permanent hanger or support purposes.

2.04 PIPE:

A. Provide each hanger or clamp for uninsulated piping with a metal-backed pipe isolating material to isolate sound vibration and electrolysis. Isolators are not required for protection sprinkler piping, waste, vent, gas, and downspout piping.

2.05 HANGER RODS:

A. Provide steel hanger rods, appropriately threaded. Provide connection points with jamb nuts or double nuts.

2.06 DUCT HANGERS AND SUPPORTS FOR NON-SEISMIC APPLICATIONS:

A. Per or NUSIG Standards.

1. Provide galvanized steel angles, channels, stays, rods, etc., for duct support. Do not use steel.

2.07 FLASHING:

A. Steel Flashing: 26 gauge galvanized steel.

B. Lead Flashing: 4 pound per square foot sheet lead for waterproofing; 1 pound per square foot sheet lead for soundproofing.

C. Safes: 5 pound per square foot sheet lead or 8 mil thick neoprene.

1. Caps: Steel, 22 gauge minimum, 16 gauge at

2.08 SLEEVES:

A. Sleeves for Pipes Passing Through Nonrated, Walls and Floors: 20 gauge, galvanized sheet metal tube with welded longitudinal joints.

B. Sieeves for Pipes Passing Through Rated Walls and Footings: Schedule 40 black steel pipe.

1. Waterproof sleeves below grade.

2. Pipes passing through fire-rated walls and floors shall be listed fire-rated assemblies.

3. Refer to Division 7 for sealants. Pipe insulation carried through the shall comply with the

C. System requirement, but shall not be less than required in Specification Section 15250 – PIPING AND EQUIPMENT INSULATION.

D. Open voids and cavities occurring in pipe sleeves passing through rated walls and floors shall be completely sealed with classified fire stop installed in strict accordance with the manufacturer's recommendations.

E. See Section 07270 Sleeves for Ducts: Form with galvanized steel.

F. Size sleeves large enough to allow for movement due to expansion and to provide for continuous insulation.

PART 3: EXECUTION

3.01 INSERTS AND DRILL-IN ANCHORS:

A. Use inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams wherever practicable. All inserts and anchors shall be installed according to the NUSIG standards.

B. Set inserts in position in advance of concrete work. Provide reinforcement rod in concrete for inserts carrying pipe over 4 inches in diameter or ducts over 60 inches wide.

C. Where concrete slabs form finished ceiling, finish inserts flush with slab surface. Expansion shields in concrete beams a minimum of 6 inches above bottom of beam.

D. Locate.

E. Do not use friction spring-type clips.

F. Use hangers which are vertically adjustable after piping is erected.

3.02 PIPE HANGERS SUPPORTS:

A. Support horizontal steel and copper piping where pipes are not braced per NUSIG or SMACNA standards.

B. Support piping joined with grooved couplings per coupling manufacturer's installation guidelines.

C. Where pipes are seismically braced, support and brace pipes per NUSIG or SMACNA.

D. Install hangers to provide minimum inch clear space between finished covering and adjacent work.

E. Support piping at each change in direction, at of branches, at base and top of risers, pipes and drops, and wherever necessary to prevent sag, bending, or vibration, in addition to the above listed hanger spacing.

F. Use hangers which are vertically 1-1½ inches minimum after piping is erected.

G. Support horizontal soil pipe on both sides of each joint, with 5’-0” maximum spacing between hangers.

H. Support vertical piping at every other floor. Support vertical soil pipe at each floor at joint.

I. Where several pipes can be installed in parallel and at same elevation, provide multiple individual hangers or trapeze hangers.

J. Where practical, support riser piping independently of connected horizontal piping.

K. Support nonmetallic piping with a sufficient number of hangers to prevent sagging and misalignment.

L. Anchor piping where shown to localize expansion or to prevent undue strain on piping and branches. Anchors to be entirely separate from hangers and of heavy forged or welded construction of approved design. All anchor designs, when submitted for approval, to include piping reactions which respective anchors.

M. Capable of supporting. Provide indicated expansion loops.

N. For piping 4 inches and larger, support the elbows of the piping adjacent to the pumps with steel supports from the floor, or the inertia base where pump is on such a base to prevent loading heavy weights of piping on pump casing.

3.03 DUCT HANGERS:

A. Where ducts are not braced, use duct hangers, supports, and installation per SMACNA Standards.

B. Where ducts are seismically braced, use duct supports and installation per or SMACNA.

C. Specific details shown on Drawings take precedence over NUSIG or SMACNA requirements.

3.04 PRIMING:

A. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipes shafts and suspended ceiling spaces are not considered exposed. See NUSIG standards.

3.05 FLASHING:

A. Flash and counterflash where mechanical equipment passes through weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes with 24 inches x 24 inches sheet lead, minimum 8 inches above roof. with caulked stack flashing sleeve, Zurn.

C. Flash floor drains over finished areas and roof drains with lead, 10 inches clear on sides, minimum 36 inches x 36 inches sheet size. Fasten flashing to drain with clamping device.

1. Provide 12 inches minimum height curbs for roof-mounted mechanical equipment. Flash and counter flash with galvanized steel, soldered and waterproofed.

D. Provide continuous lead or neoprene safes below built-up mop sinks, built-up shower stalls, shower room floors not installed on grade. Solder at joints, flash into floor drains, and up 6 inches into walls or to top of curbs, and caulk safing not required under prefabricated shower units on any level.

3.06 SLEEVES:

A. Set sleeves in position in advance of concrete work. Provide suitable reinforcing around sleeves.

B. Where piping or passes through floor, ceiling or non fire-rated wall, close off space between pipe or duct and construction with noncombustible insulation. Provide tight-fitting metal caps on both sides and caulk.

C. Install chrome-plated escutcheons where piping passes through finished surfaces.

D. Provide pipe sleeves for all mechanical piping.

E. Adequately sleeve pipe passing through concrete or masonry walls or concrete slabs to receive both pipe and insulation pertaining thereto.

F. Seal pipes passing through walls or slabs. Use mastic or oakum seal in the annular space in walls.

G. Insulated pipe shall be insulated in sleeves, sealed, and pointed as above sleeves on pipes as they are being hung, ready for proper placement in wall as wall is being constructed.

H. Where sleeves are required in existing concrete decks, provide requisite pipe opening by using properly sized diamond core drills after coordination with CONTRACTOR. Areas located below drilling operations shall be protected possible damage.

I. Provide escutcheon plates of the proper size for piping in sleeves passing through walls, furrings, partitions, hung ceilings, etc., throughout the where exposed (exposed escutcheons to be cast brass chromium plated, bell type, with set screws of sufficient diameter to include any required pipe insulation).

J. Provide and grouting around pipes and ducts penetrating concrete slabs, concrete walls and masonry walls with cement grout in the sleeved opening extending full depth through wall or floor.

K. Provide sheet metal cover over the insulation before applying grout. Around pipes and ducts through fue rated dry wall construction, pack the annular space between the wall sleeve and the insulation sheet metal cover with noncombustible approved material and finish with 20 gauge sheet metal collar on ducts escutcheons on

L. Attach escutcheons to wall, not pipe.

M. Pads or curbs shall be provided for all equipment. This shall include floor mounted equipment, equipment mounted on legs and pipe support stands. Equipment pads and curbs shall generally be 4” high nnd conform to the shape of the piece of equipment it serves with a minimum 3” margin around the equipment and supports, seismic restraints, etc. Where indicated, pads and curbs shall be larger.

N. Install galvanized anchor bolts for all equipment placed on concrete equipment pads or on concrete slabs. Bolts shall be of the size and number recommended by the Manufacturer of the equipment of suitable templates. When equipment is placed on vibration isolators, the equipment shall be secured to the isolator and the isolator secured to the floor, pad, or support as recommended by the vibration isolation manufacturer.

O. Where temperature control panels, motor controllers, etc., are mounted on gypsum board partitions, the mounting screws shall pass through the gypsum board and be securely attached to the partition through the gypsum board be securely attached to 6" square, 18 gauge galvanized metal backplates which are attached to the gypsum board with approved non-flammable adhesive. Toggle bolts installed in gypsum board partitions will not be acceptable.

PART 4: MEASUREMENT AND PAYMENT

SUPPORTS, ANCHORS, AND SEALS

4.01

A. The work specified under this section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS
PART 1: GENERAL

1.01 DESCRIPTION:

A. The Work of this Section consists of furnishing basic electrical materials and methods applicable to electrical work for installation of systems specified in other sections, except as may be modified in those sections. The electrical work includes installation of systems for transformation, transmission, or distribution of power and data used for operation of surveillance equipment.

B. Related Work Specified Elsewhere:

1. Section 01110 – General Requirements
2. Section 16060 – Grounding and Bonding
3. Section 16135 – Underground Duct Work

1.02 QUALITY ASSURANCE:

A. Materials specified shall meet or exceed the requirements of the cited references.

B. Productions tests shall be performed on materials and certified by the Manufacturer.

C. All components and materials shall be UL listed.

1.03 SUBMITTALS:

Submit the following in accordance with SUBMITTALS, Section 01300, and with the additional requirements as specified for each:

A. Provide manufacturer's standard catalog data for all items described in this specification indicating conformance and compliance with standards and criteria indicated (CDRL).

B. Manufacturer's description, shop drawings, installation and operational instructions (CDRL).

C. Proof of compliance with NEC requirement to be listed and approved (CDRL).

PART 2: PRODUCTS

2.01 GENERAL:

A. Materials furnished shall be standard products of manufacturer regularly engaged in the production of materials specified.

B. All associated hardware (including but not limited to screws, bolts, nuts, strut, and washers) for exterior junction boxes, pullboxes, conduit and mounting components shall be stainless steel.

C. Galvanized coatings shall comply with ASTM A123 and A153.

D. Repair of galvanized coatings shall comply with ASTM A780.

2.02 GALVANIZED RIGID STEEL CONDUIT (GRS) AND FITTINGS:

A. Conduit, couplings, condulets, conduit bodies, elbows, fittings, and nipples shall be hot-dip galvanized and shall meet the requirements of ANSI C80.1, FS WW-C-581 and UL 6.

B. Conduit fittings and conduit bodies shall be threaded type connections, material shall be malleable iron with galvanized or zinc plated finish complying with ANSI/NEMA FB1.

C. Expansion fittings grounding and bonding jumpers shall be braided tinned copper with malleable iron clamps

D. Nipples shall not have continuous running threads. Continuous running threaded conduit shall not be permitted.

E. All conduit supports and associated components shall be galvanized or zinc plated malleable iron conduit with spacers or stainless steel strut, spring nuts, and clamps.

2.03 ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS:

A. Tubing, couplings, condulets, conduit bodies, elbows, and fittings shall be galvanized and shall meet the requirements of ANSI C.80.3 and UL 514B.

B. Expansion fittings grounding and bonding jumpers shall be braided tinned copper with steel clamps.

C. Fittings shall be set-screw type complying with ANSI C.80.3 and UL 514.

2.04 LIQUID-TIGHT FLEXIBLE METALLIC CONDUIT (LFMC) AND FITTINGS:

A. Liquid-tight flexible metal conduit shall be zinc-coated galvanized steel with moisture, oil, and sunlight resistant PVC jacket complying with UL 360.

B. All liquid-tight flexible metal conduit of 1¼ inches diameter and smaller shall have a continuous copper bonding conductor spiral wound between the convolutions.

C. All liquid-tight flexible metal fittings shall be galvanized or zinc coated steel complying with ANSI/NEMA FB 2.

2.05 POLYVINYL CHLORIDE (PVC) COATED GALVANIZED RIGID STEEL CONDUIT, FITTINGS AND ACCESSORIES:

A. Coated conduits, fittings, elbows and couplings shall be coated with a minimum coating thickness of 20-mils of polyvinyl chloride complying with FS WW-C- 581, NEMA RN 1, and UL 6.

2.06 POLYVINYL CHLORIDE RIGID CONDUIT (PVC) AND FITTINGS:

A. Schedule 40 and schedule 80 conduits shall comply with NEMA TC 2 and UL 651 and have the following properties:

1. Flammability: ASTM D635, self-extinguishing.

2. Tensile Strength: ASTM D638, 6,000 psi at 78° F.

3. Flexural Strength: ASTM D790, 12,500 psi.

4. Compressive Strength: ASTM D695, 4,000 psi.

5. Hardness: ASTM D2240 (Durometer D) 77.

6. Water absorption: ASTM D570, 0.03 percent maximum, in 24 hours at 72° F.

7. Dielectric strength: ASTM D149, 1,100 volts per mil.

B. Conduit cement and primer: As recommended by the conduit manufacturer.

C. All polyvinyl chloride conduit fittings shall be rigid schedule 40 or schedule 80 complying with NEMA TC3 and UL 514B.

D. All polyvinyl chloride conduit spacers shall be thermoplastic interlocking type.

2.07 CONDUIT EXPANSION FITTINGS:

A. End couplings shall be of the same material as those of conduits to be coupled.

B. Neoprene sleeves attached to the end couplings by stainless steel bands shall accommodate an axial expansion or contraction from normal of ¾" minimum in either direction, parallel misalignment of the axis of coupled conduit runs in any direction of ¾" minimum and an angular misalignment of the axis of coupled conduit runs, in any direction, of 30°.

C. A tinned flexible copper braided bonding jumper, integral with the expansion fitting shall be attached to the end couplings to provide electrical continuity for all metal conduits.

Note: Cable Tray

All cable tray shall be approved by the Engineer prior to use and this approval will be allowed in limited locations.

2.08 STEEL CABLE TRAYS:

A. Steel trays shall be ladder type or ventilated solid bottom type as required and shall be hot-dip galvanized after fabrication in accordance with ASTM A386. The trays shall be designed to comply with the requirements of NEMA VE 1.

2.09 FIBERGLASS CABLE TRAYS

A. Fiberglass trays shall be ladder type, manufactured from fiberglass reinforced polyester resin, designed as follows, in accordance with NEMA FG-1:

1. Dimensions – Inside usable depth shall be four inches minimum. Outside depth shall be six inches maximum.

2. Fitting Radius – 24 inches

3. Rung Spacing – Maximum nine inches between centers

4. Working Load – 50 pound per linear foot on a maximum span of eight feet with a safety factor of 1.5

5. Fabrication – Straight section shall consist of rungs located between channel-shaped side rails

6. Flame Spread Index – ASTM E84, 25 maximum

7. Smoke Density – ASTM E84, 450 maximum

B. Covers – All cable trays inside the substation shall have snap-on construction covers.

2.10 METAL FRAMING AND WIREWAYS

A. Metal Framing (Continuous Slot Metal Channel System) – Comply with the following requirements:

1. Channel – Steel, ASTM A569 Where used as a raceway and lighting fixture support, channel shall be listed by UL as complying with UL5 for use as surface raceway and support for lighting fixtures with electric discharge lamps.

2. Configuration – Single channel or two single channels welded together. Channels shall accept spring-held steel nuts.

3. Single Channel Dimensions – 1-⅝ inch by 1-⅝ inches, 12 gauge

4. Double Channel Dimensions – 1-⅝ inch by 3-¼ inches, 12 gauge

5. General Fittings Dimensions, for Flat, Angular and U-Shapes – ¼ inch thick by 1-⅝ inches wide, unless otherwise indicated.

6. Channel, Pipe Clamps, and General Fittings Finish – Hot-dip galvanized after fabrication, ASTM A386, as applicable.

7. Nuts, Bolts, and Screws Finish – Electro-deposited zinc coating, ASTM B633, Class Fe/Zn 5, Type III.

B. Wireways – Galvanized sheet steel with screw covers, complying with UL 870.

2.11 JUNCTION AND PULL BOXES:

A. Exposed junction boxes and pullboxes, installed outdoors or in locations subject to moisture, shall be NEMA 3R or 4X, galvanized/zinc plated malleable iron with integrated tapered threaded hubs or stainless steel with rain-tight threaded hubs and metallic insulated bushings.

B. Concealed or interior junction boxes and pullboxes, installed in dry locations, shall be NEMA 1 or 12, galvanized/zinc plated steel.

C. All junction boxes and pullboxes rated NEMA 3R, 4X and 12 shall have covers with gaskets.

D. All boxes shall be equipped with at least one #10-32 tapped grounding screw hole and screw.

E. All boxes covers shall be of same material.

2.12 EMBEDDEDOR DIRECT BURIED HANDBOXES:

A. Handboxes shall be high impact resistant polymer concrete with open bottom, heavy vehicle traffic load rated box and non-skid lid with neoprene gasket, stainless steel penta head captive bolts, and MTA approved logo.

B. Size shall be 13 inches wide by 24 inches long by 12 inches deep.

C. MTA logo shall be: “MTA ELECTRIC” OR “MTA COMMUNICATIONs” as indicated on Contract Documents.

2.13 HANGERS AND SUPPORTS :

A. Hanger rods shall be hot-rolled steel ½ inch diameter (minimum) threaded the full length with sufficient distance at each end to permit at least 1-1/2 inches of adjustment. Conforming to ASTM A575 and A576.

B. Electro-deposited zinc coating conforming to ASTM B633.

C. Multiple Conduit Horizontal Members:

1. Standard structural steel shapes such as stainless steel angles or channels, 1½ by 1½ or $1^5/_8$ by $1^5/_8$ inches, 12 gauge, stainless steel cold-formed, lipped channel, and designated to accept special spring-held hardened stainless steel nuts for securing hanger rods and other attachments.

2. Two (2) or more channels may be welded together to form horizontal members of greater strength than single channel.

3. All associated hardware (including. But not limited to, screws, bolts, nuts and washers) shall be stainless steel.

D. Design:

1. Capable of supporting a load equal to the sum of the weights of the conduits and wires, the weight of the hanger itself, plus 200 pounds.

2. The stress at the root of the thread of the hanger rods; not more than 9,475 psi at design load.

3. Size the horizontal member such that the maximum stree will be not more than 12,650 psi at design load.

2.14 GROUNDING AND BONDING:

A. Per SECTION 16060 - Grounding and Bonding and Contract drawings.

2.15 WIRING DEVICES:

A. Receptacles:

1. Receptacles shall be extra heavy duty specification grade thermoplastic nylon with side screw terminals, bonded yoke, and #8-32 ground screw.

2. Color shall be black or brown.

3. Receptacle NEMA configuration shall be as indicated on Contract Documents.

4. Cover plates shall be stainless steel of configuration required for device.

2.16 CONDUIT TAGS:

A. Conduit tags shall be 1½ inch diameter 3-ply acrylic with black core and matte yellow front and back with quarter inch laser engraved lettering.

2.17 NYLON TIES STRAPS:

A. Nylon tie straps shall be a heavy duty UV (sunlight) resistant nylon with a stainless steel self-locking metal tab, and 50 lb. minimum tensile strength, sized to suit the application.

2.18 CONDUIT MEASURING TAPE AND PULLSTRING:

A. Tape and pullstring shall be 3/16 inch wide; rot, mildew and waterproof proof polyester with permanently printed measurements every foot, tangle proof, and 200 lbs tensile strength.

2.19 FIRESTOPS AND SMOKESTOPS:

A. Sealant compound shall be flexible, latex based, ready-mix mortar or caulk type providing tight seal complying with ASTM E814 or UL 1479.

B. Forming material shall be noncombustible, high-melt mineral fiber insulation containing a 4 lb cubic foot density and zero smoke development complying with NAFA 220, ASTM C665, Type 1 and E136.

2.20 UNDER GROUND DETECTABLE WARNING TAPE:

A. Underground detectable warning tape shall be metallic 6" wide 5-mil double-laminated permanently black-lettered color coded per APWA standards: Electric – Red.

PART 3: EXECUTION

3.01 GENERAL:

A. Installed work shall be in accordance with applicable requirements of NFPA 70 and shall comply with the current version of the NEC and local codes.

B. Materials and equipment shall be installed and connected as recommended by the manufacturer.

C. Install electrical materials, equipment, appurtenances, and accessories in locations as indicated, rigid and secure, plumb and level, and in alignment with related and adjoining work to provide a complete and operable system. Do not weld electrical materials for attachment or support.

D. All exposed conduit shall be galvanized rigid steel unless otherwise indicated. Quick or split couplings shall not be utilized.

E. Electrical metallic tubing shall be permitted in architecturally finished interior NEMA 1 rated spaces. Electrical metallic tubing shall be concealed within walls and above ceilings in public spaces.

F. All embedded or encased conduit shall be schedule 40 or schedule 80 polyvinyl chloride unless otherwise indicated. If schedule 40 conduit is used under railroad tracks it shall be encased in concrete. Schedule 80 conduit used beneath railroad tracks need not be encased in concrete. Schedule 40 or schedule 80 conduit under roadways shall be encased in concrete.

G. All embedded or encased conduit stub ups or stub outs shall transition to polyvinyl chloride coated galvanized rigid steel prior to leaving concrete or earth. Minimum length shall be eighteen inches straight conduit or conduit elbow. Both shall be furnished and installed with a coated threaded coupling for the transition to exposed conduit.

H. All conduits shall be mandrelled after installation with mandrel of appropriate size for the particular conduit. Plug or cap mandrelled conduits to protect installed conduit against entrance of dirt, moisture, or foreign matter.

I. Contractor shall install expansion fittings on all exposed or embedded conduit runs crossing contraction, construction, and expansion joints.

J. Embedded conduits shall be supported and spaced prior to concrete placement or backfilling.

K. Conduits shall be pitched to provide moisture drainage to the nearest handhole, manhole, pull box (or away from equipment enclosures).

L. Conduits shall be rodded, or wire brushed, and swabbed prior to the installation of cables and conductors. After cleaning conduits, pull strings shall be installed and the conduits and outlet boxes shall be capped and sealed until installation of cables and conductors.

M. Field cut conduits shall be reamed to remove rough edges and burs.

N. When field cutting of concrete is required, thread and ream the conduit to remove any rough edges and clean off all cutting and threading oils by using an air drying solvent. Apply conductive ant-seize compound to the threads of all rigid conduit joints. Do not use compounds containing lead.

O. Conduit shall be brought to the shoulder of fittings and/or couplings and fastened securely.

P. There shall be no more than the equivalent of three 90° bends between boxes and devices.

Q. Polyvinyl chloride conduit shall be primed and cemented together as recommended by the manufacturer to ensure a watertight connection.

R. Conduits exposed to different temperatures shall be sealed to prevent condensation and passage of air from one area to the other.

S. Conduits shall be mechanically and if metallic electrically continuous.

T. All conduits shall be designated with conduit tags at each end of run and at all intermediate boxes. Tags shall be fastened with nylon tie straps.

U. Bushings shall be install on all conduit ends in outlet boxes and pull boxes.

V. Each conduit designated as “SPARE” shall have measure tapes/pullstrings. Ensure each tape/pullstring is free of splices, have ample exposed length and securely fastened on each end.

W. Hydraulic one-shot conduit bender or factory elbows shall be used for bends in conduit larger than 2 inch size.

X. Moisture traps shall be avoided where possible. Where unavoidable, a junction box with drain fitting shall be installed at the conduit low point.

Y. Conduits containing fiber optic cables shall utilize conduit sweeps and boxes maintaining fiber optic cable manufacturers’ minimum bend radius requirements. Minimum conduit bend radii shall be twenty four inches, unless otherwise indicated.

Z. Embedded or direct buried hand boxes shall be installed on six inches of crusher run aggregate. All boxes installed in sidewalks, walkways, platforms, and roadways shall be flush with finish grade and all boxes installed in grass, mulch, or ballast areas shall be one inch above finish grade.

AA. Contractor shall drill platforms, floors, and walls, as required, to accommodate conduit runs with bit of correct size to permit proper conduit installation and sealing. All penetrations shall be sealed water tight and fire/smoke rated as required by requirements and regulations.

AB. Penetrations of existing fire walls and slabs shall not degrade fire rating and openings shall be sealed with approved fire rate methods and materials.

AC. Penetration of existing concrete slabs/floors, elevated platforms, and walls for conduits and other wiring devices shall be made only by core drilling. Chipping or hammering shall not be permitted. Openings around conduits shall be sealed with an approved patching materials and finishes.

AD. Junction and pull boxes shall be installed so that covers are readily accessible after completion of the installation.

AE. All work shall be performed in an orderly and workman like manner.

AF. Pull Strings: installed in all conduits with tensile strength not less than 200 pounds; free of splices, and having ample exposed length at each end; cap unused conduits with pull string in place, seal with pliable watertight sealant.

AG. Conduit entrances shall be sealed to prevent infiltration of dirt, moisture and rodents.

3.02 CABLE TRAYS, METAL FRAMING AND WIREWAYS:

A. Trays and wireways shall be supported by metal frame support or hangers of sufficient strength to carry combined weights of tray and cable and the dynamic loads imposed during cable pulling.

B. Electrical continuity shall be maintained between sections of steel tray by bolted copper braid and the steel tray connected to local grounding system.

C. AC and DC cables shall be installed in separate raceways. All DC power cables shall be installed in non-metallic raceways, unless noted otherwise.

3.03 JUNCTION AND PULL BOXES:

A. Junction and Pull Boxes:

1. Junction and pull boxes shall be installed so that covers are readily accessible after completion of the installation.

B. Boxes Set in Concrete:

1. Boxes shall be supported to prevent movement during concrete placement.

2. Boxes shall be sealed to prevent infiltration during concrete placement.

3. After concrete placement clean and cover boxes until installation of cables and conductors.

3.04 WIRING DEVICES:

A. Wire Terminations: All wiring shall be terminated with approved connectors and lugs. Provide adequate slack wire, one loop minimum, to prevent strain on terminations.

B. Crimped terminations: Crimping tools shall be as recommended by the termination device's manufacturer.

C. Exterior junction boxes, light fixtures, receptacles and switches shall be approved for wet locations with watertight cast type boxes with threaded hubs and equipped with gasketed covers with captive screws or twist type.

D. Equipment permanently connected to exterior receptacles or in areas subject to wet conditions or spray shall be equipped with watertight male plugs to suit.

3.05 WAYSIDE JUNCTION BOXES AND TERMINAL CASES:

A. Wayside Junction Boxes and Terminal Cases shall be installed such that no part, including doors in the open position, will project into the vehicle clearance envelope.

B. Terminate all conductors and cables on internal terminal blocks.

C. Install engraved placards on the exterior of the covers and/or door to identify the location.

D. Place copy of the wiring diagrams in the container provided.

E. Cable supports inside the enclosures shall be used to avoid straining terminations and to maintain an orderly installation.

3.06 GROUNDING AND BONDING:

A. Per SECTION 16060 – Grounding and Bonding.

3.07 FIELD TOUCH-UP:

A. Galvanized Metal Surfaces: Coat damaged surfaces to meet the finish of the original coating with polystyrene organic rich compound containing not less than 91 percent by weight metallic zinc powder in dried film.

B. Painted Metal Surfaces: Clean, prime and coat damaged surfaces with rust inhibiting undercoating and apply a finish paint coat system in accordance with manufacturer's instructions.

C. Damage Repair: Repair minor damage surfaces with materials and methods as recommended by the manufacturer. Major damage shall require complete component replacement as directed by the Engineer at no additional cost to the MTA.

PART 4: MEASUREMENT AND PAYMENT

4.01 BASIC ELECTRICAL MATERIALS AND METHODS:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for furnishing and installing complete grounding protection systems for the surveillance camera system and components.

B. Related Work Specified Elsewhere:

1. Section 01000 – Summary of Work
2. Section 16050 – Basic Electrical Materials and Methods
3. Section 16123 – Cabinets and Enclosures
4. Section 17520 – Wide Area Network Communication Cabinets

C. The ground systems shall meet the requirements of the National Electrical Code and the technical & safety recommendations of ANSI and IEEE.

D. The Contractor shall provide grounding for all metal components and materials of the surveillance camera system.

E. All grounding system work shall meet the field testing requirements specified herein.

1.02 APPLICABLE STANDARDS:

A. Pertinent provisions of the following listed standards shall apply to the work of this Section, except as they may be modified herein, and are hereby made a part of this Specification to the extent required.

1. National Fire Protection Association (NFPA):

   70 National Electrical Code

2. Underwriters' Laboratories, Ins (UL):

   467 Grounding and Equipment

1.03 GENERAL REQUIREMENTS:

A. Regulatory Requirements:

1. The Contractor shall comply with requirements in following order of precedence:

   a. Codes, laws, ordinances, rules, regulations, or orders of any public authority having jurisdiction over installation, materials, inspection, and testing, including local electrical codes and requirements.

b. Applicable provisions of the National Electrical Code (NEC), NFPA 70, latest edition.

2. Manufacturing workmanship and materials shall comply with applicable provisions of NEMA, ANSI, ICPA, and UL standards.

3. Electrical equipment shall be UL listed and comply with UL standards in all cases where UL has published lists and standards applicable to type of equipment required to be provided.

B. Grounding method should be designed to minimize the noise voltage generated by currents from two or more circuits flowing through common ground impedance and to avoid creating ground loops which are susceptible to magnetic fields and differences in ground potential.

C. Bonding shall be implemented through direct metal-to-metal contact. Continuous or multi-point bonding shall be preferred over single contact to reduce the concentration of high current densities at the point of contact.

1.04 SUBMITTALS:

A. Submittals shall be made in accordance with specified requirements.

B. The Contractor shall submit the grounding and bonding methodology for all installations (CDRL). The contractor shall include all grounding and bonding information on schematics and installation drawings.

C. The Contractor shall submit product data, but not limited to, the following items (CDRL):

1. Ground rods
2. Wire and cable
3. Exothermic connections
4. Bolted connectors
5. Bituminous resin compound

PART 2: PRODUCTS

2.01 BARE GROUND WIRE:

A. Soft drawn copper, Class A or Class B stranded, meeting the requirements of ASTM B8, size in accordance with the NEC except where the sizes specified herein or shown on the indicative drawings are larger than those required by the NEC; UL listed.

2.02 INSULATED GROUND WIRE:

A. Copper, Class B stranded, meeting the requirements of ASTM B8, 600-volt, 90° C butyl rubber insulated, neoprene jacketed, NEC type use; sized as described in 2.01 above; UL listed.

2.03 WIRE AND CABLE SIZE:

A. Conductors No. 10 AWG and smaller shall be solid.

B. Conductors No. 8 AWG and larger shall be stranded.

2.04 EXOTHERMIC WELDED CONNECTIONS:

A. Use products for copper Exothermic welded connections, which are the products of one manufacturer and are produced for the specific application for which they are used.

B. Bituminous Resin Coating Materials for Exothermic Welded Connections: Use black, rubber based bituminous resin compound coating materials, which are soft, permanently pliable, moldable, and unbacked, not less than 1/8 inch thick, with properties as follows:

1.	Solids	100 percent.
2.	Density	12.0 pounds per gallon minimum.
3.	Penetration	90-130 ASTM D5.
4.	Water Absorption	0.10 percent maximum ASTM D570.
5.	Dielectric Strength	500 volts/mil. ASTM D149.
6.	Volume Resistivity	2,000 megohms - inches ASTM D991.
7.	Service Temperature	–40° to 160° F.
8.	Chemical Resistance	Melting point, none; flammability, slow burning (ASTM C653); resists alcohol, water, aqueous hydrochloride, and sodium hydroxide; dissolved by carbon tetrachloride, naphtha gasoline, mineral spirits, ketones, and benzene.
9.	Highly cohesive	Adheres strongly to metals and adhesive concrete and to itself.

C. Manufacturers shall be Royston: Roskote R28 or approved equal.

2.05 BOLTED GROUND CONNECTORS:

A. Solderless type made of high strength electric bronze with silicon bronze clamping bolts and hardware; designed such that bolts, nuts, lock washers,

and similar hardware which might nick or otherwise damage the ground wire will not directly contact the ground wire. Sizes shall be based on ground wire size.

2.06 GROUND RODS:

A. Medium carbon steel, copper clad by the molten weld casting process, UL approved, 3/4 in diameter 8 feet long, and to have conductivity of not less than 27 percent pure copper. Rod point shall be provided with a steel alloy cone and the driven end provided with a removable driving stud. Ground rods shall comply with NEC requirements.

PART 3: EXECUTION

3.01 GROUNDING:

A. The work shall be arranged in such a manner that each part of the grounding system which is laid below finished grade shall be complete, inspected and tested before backfilling is done. All precautions shall be taken to assure that no damage is done to grounding conductors or connections during backfill, compaction and concrete operations. Testing for ground resistance shall be performed in accordance with the requirements of this Specification before any finish surfacing is laid above the grounding conductors.

B. Grounding connections to equipment shall be made at the points provided on the equipment for grounding, in accordance with the manufacturers' recommendations. Where ground points are not provided, equipment, structures shall be drilled and connection made by means of a ground wire connection with bolts and nuts, or the equipment or structure shall be drilled, tapped and connected by means of a ground screw or post-type connector, as approved by the Engineer. All paint, scale, rust, oxidation, and/or foreign material shall be thoroughly removed from the points of contact on the metal surfaces before any ground connections are made.

C. Provide a permanent and continuous grounding path for all circuits, equipment, and raceways.

D. Provide a separate, insulated equipment grounding conductor for each feeder and branch circuit.

E. Provide grounding for all poles, rebar, and grade mounted junction & pull boxes.

F. Ground rods shall be separated from adjacent buried metallic structure or pipe by a minimum of 2 feet, and top of ground rods shall be buried a minimum of eight inches below finished grade.

G. All exposed ground connections shall be compression type, unless otherwise indicated.

H. All concrete encased or direct buried ground connections shall be exothermic welds, cleaned and coated with approved bituminous resin compound.

3.02 EXOTHERMIC WELDING CONNECTIONS:

A. All exothermic welding shall utilize the manufacturer's recommended molds and size of charges for the application.

B. Prepare the material to be welded and perform exothermic welding in accordance with manufacturer's instructions.

C. Test completed exothermic welds before coating by striking with two pound hammer. If cracks develop, replace welds at no additional expense to the Administration. When required by the Engineer, test the electrical continuity of bonds.

D. Apply coating so that it extends one inch beyond point of attachment to steel member, overlaps wire coating one inch, and provides insulation thickness equivalent to wire insulation, but not less than 1/8 inch in thickness. Do not apply coating material at ambient temperatures below 20° F. or above 125° F. Maintain, by an approved method, curing temperature within above temperature range for at least four hours after application of coating. Protect coating by approved means until embedment.

3.03 TESTING:

A. General: Per SECTION 17125 Testing and Inspection and the following.

B. Furnish all equipment required and conduct tests to demonstrate to the satisfaction of the Engineer the following:

1. Measure resistance between ground and absolute earth without benefit of chemical treatment or artificial means.

2. The ground resistance test shall be done using a Biddle Megger Earth Tester, or approved equal, per the manufacturer’s instructions. Test leads shall be placed at 60 feet and 100 feet from the testing rod. The meter is to be zeroed before each reading.

3. Resistance to absolute earth shall not be more than 25 ohms. If readings higher than 25 ohms are recorded, corrective action shall be taken under the direction of the Engineer and new test initiated before acceptance of the ground rods with no additional cost to the Administration.

4. After testing of individual ground rods, final grounding connections may be made.

C. For equipment to be installed in facilities with existing grounding systems, the Contractor shall be required to perform Two-point Tests to verify that

the impedance between the new equipment ground and the ground bus serving the equipment, and between all new ground buses and the building grounding system, meet NEC and State regulations.

PART 4: MEASUREMENT AND PAYMENT

4.01: GROUNDING AND BONDING:

A. The work required under this Section will not be measured for payment.

B. All costs in connection herewith will not be paid for directly, but will be considered incidental to the item of work to which they pertain.

END OF SECTION

SECTION 16135
UNDERGROUND DUCT WORK
PART 1: GENERAL

1.01 DESCRIPTION:

A. Work Included: The work specified in this Section includes the supply and installation of concrete-encased duct banks, direct buried conduits, hand boxes, and precast concrete manholes / handholes.

B. Related Work Specified Elsewhere:

1. Section 01300 – Submittals
2. Section 02310 – Excavation and Backfill
3. Section 03050 – Portland Cement Concrete
4. Section 03210 – Concrete Reinforcement
5. Section 03300 – Cast-In-Place Concrete
6. Section 16050 – Basic Electrical Materials and Methods
7. Section 16060 – Grounding and Bonding

1.02 QUALITY ASSURANCE:

A. Materials specified shall meet or exceed the requirements of the citied references.

B. Production tests shall be performed on materials and certified by the manufacturer.

C. All components and materials shall be UL listed.

1.03 CITED REFERENCE:

A. SECTION 01420 – Reference Codes and Standards.

1.04 SUBMITTALS:

A. Contractor shall submit as specified in Section 01300 SUBMITTALS and the following:

1. Catalog data on non-metallic conduit, metallic to non-metallic conduit couplings, hand boxes, manhole/handhole inserts, cable support materials, waterproofing sealer, concrete curing compound, and concrete dye additive (CDRL).

2. Shop drawings of precast manholes and handholes, which shall show all accessories including layout of cable supports (CDRL). The Contractor shall not commence the construction of the precast manholes and

handholes until the drawings are approved by the MTA and as required the City of Baltimore.

3. Conduit Plans (CDRL): Include for both interior and exterior work.

PART 2: PRODUCTS

2.01 MANHOLES AND HANDHOLES:

A. Manholes/handholes may be constructed monolithically or in sections. If the manhole is constructed in sections, the joint between sections shall be made watertight with an approved gasket or with an approved epoxy mortar grout.

1. Immediately after removal of forms, concrete surfaces shall be coated with an approved curing compound. The manhole opening shall be centered in the roof slab and ductbank knockouts shall be centered in the walls, unless otherwise noted.

2. Access opening shall be constructed in size and shape to accommodate the iron cover and frame.

3. Manholes and handholes shall include ductbank knockouts, riser conduit knockouts, a sump with galvanized grate and a minimum depth of two inches, a ground rod, 7/8 - inch minimum diameter galvanized steel pulling irons (8 per manhole, 4 per handhole), cable racks, and cast iron cover with lifting hooks.

B. Size: Minimum inside dimensions of manholes shall be as indicated on the Contract Documents.

C. Design Loads: Manhole and handhole design loads shall consist of live loads, live load impact, dead load, soil loads, hydrostatic loads, and any other excepted loads that may occur.

1. Live loads shall for H-20-44 AASHTO Standard Specifications for Highway Bridges. The design load shall be 16kips.

2. Impact loading shall be 30 per cent of the live load.

3. Soil loads shall consist of an earth cover over manhole from 0 ft. minimum of 5 ft. maximum. Average unit weight of earth shall be assumed to be 100 lb. per cu. Ft.

4. Hydrostatic loading shall be a hydrostatic head of 9 ft. above base of manhole.

D. The drawings shall be approved and signed by a Civil or Structural engineer registered in the State of Maryland.

E. Concrete: Cement for concrete shall be portland cement meeting the requirements of ASTM C150, Type I or Type II. Concrete shall be thoroughly cured and shall attain a compressive strength of at least 3000 psi before delivery, and 4000 psi before installation. The proportions of materials for concrete shall be as follows:

1. Minimum number of sacks of cement per cu. yd. of concrete – 7.

2. Maximum size of coarse aggregate in inches – 3/4.

3. Maximum slump in inches – 4.

F. Concrete reinforcing bars shall be in accordance with the provisions of Section 03210.

G. Exterior surfaces shall be waterproofed with 2 coats of waterproofing sealer. The sealer shall be applied when the manholes are manufactured and touched up in the field as required to repair damage during shipping and to seal field penetrations as specified in Subarticle 3.03D. The sealer shall be applied in accordance with the manufacturer's recommendations.

H. Ground rods shall be in accordance with Section 16060.

2.02 MANHOLE AND HANDHOLE FRAMES AND COVERS:

A. Manholes frames and covers shall be as indicated on Bid Documents. Manholes frames and covers shall be cast from gray iron in accordance with the applicable requirements of ASTM A48, Class 30. The transverse bending tests shall be considered the primary test for qualification and shall be conducted in accordance with the requirements of AST-438.

B. Cleaning and Inspection:

1. All castings which have passed the required tests shall be thoroughly cleaned, inside and out, without the aid of acid or other liquid and shall be subject to careful inspection and hammer tests.

2. The castings shall be the dimensions indicated on the Contract Documents and shall be free from sand or blow holes and cold shuts. No plugging or stopping of holes will be allowed. Casting lines and excess material shall be ground smooth.

2.03 CABLE SUPPORT:

A. Cable racks shall be surface mounted, with stainless steel bolts, to three 1/2 inch stainless steel anchor inserts, embedded and anchored to the reinforcement bars, and installed vertically, approximately two feet apart on each wall, without blocking any ductbank openings for the new or future duct banks.

1. The exact location and quantity of cable racks depend upon the exact locations of the precast duct bank knockouts in each style of manholes/handhole, and shall be subject to approval by the MTA and as required, the City of Baltimore.

2. Cable racks inserts shall be hot dipped galvanized, 4 feet long minimum (2 feet long minimum for handholes).

B. Contractor shall furnish hot-dipped galvanized cable brackets and porcelain cable supports, compatible with the manholes/handhole hardware as specified herein, or equal:

Wall Support	Cable Bracket	Porcelain Support
Unistrut type Channel	Kin Line #320-12	Kin Line #PCS 1500
T Slot Channel	Joslyn #J5133A	Joslyn #J5122
Pipe Socket	1" galv. Pipe	Gladding #301-A

2.04 EMBEDDED OR DIRECT BURIED HANDBOXES:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

2.05 WATERPROOFING:

A. Sealer for waterproofing exterior surfaces of manholes shall be a mineral colloid type asphalt emulsion, as manufactured by Hunt process Company "Acqu Shield 124", or equal.

2.06 GROUNDING AND BONDING:

A. Per SECTION 16060 – Grounding and Bonding.

2.07 AGGREGATE:

A. Per SECTION 02310 – Excavation and Backfill.

2.08 GROUT:

A. Non-shrinking, non-metallic grout shall be in accordance with ASTM C150 premixed compound capable of minimum compression strength of 4000 psi.

B. Water shall be clean and free of deleterious substances.

C. Non-shrinking, non-metallic grout shall be factory pre-mixed requiring only water addition in the field.

D. Shrinkage shall be in accordance with ASTM C827.

2.09 CONCRETE-ENCASED DUCT BANK:

A. Concrete encasement shall have a compressive strength at age 28 days of not less than 2500 psi. The maximum size of aggregate shall be 1/2 inch. The concrete shall be dyed red with an approved concrete additive.

1. Slump shall be between 4 and 6 inches. Concrete shall contain not more than 6.75 gallons of water per sack of cement. Consistency and workability for placement shall be obtained by the addition of a suitable type and amount of an air-entraining or water-entraining admixture, or both.

B. Conduits, fittings and spacers: Per SECTION 16050 – Basic Electrical Materials and Methods.

2.10 DIRECT BURIED CONDUITS:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

2.11 BACKFILL:

A. Per SECTION 02310 – Excavation and Backfill.

2.12 UNDERGROUND DETECTABLE WARNING TAPE:

A. Per SECTION 16050 – Basic Electrical Materials and Methods.

PART 3: EXECUTION

3.01 GENERAL:

A. Embedded or direct buried handboxes shall be installed on six (6) inches of aggregate. All boxes installed in sidewalks, walkways and roadways shall be flush with finished grade, and all boxes installed on grass, mulch, ballast areas shall be one (1) inch above finished grade.

B. Conduits shall be installed as shown on the Contract Documents.

C. All concrete slab or asphalt paving sections to be removed shall be neatly cut with a wet saw at limit of removal.

D. All restored concrete slab or asphalt paving sections shall match existing cross sections and finishes.

E. Backfill shall be compacted per SECTION 02310 – Excavation and Backfill.

3.02 EXCAVATION AND BACKFILL:

A. Per SECTION 02310 – Excavation and Backfill.

3.03 INSTALLATION OF PRECAST MANHOLES/HANDHOLES:

A. The contractor shall install precast concrete manholes as indicated on the Contract Documents and as approved by the MTA and, as required, the Baltimore City.

B. Manholes cover and frame shall be installed as shown on the approved shop drawings. Cover frame shall be adjusted flush with finish grade.

1. Within Baltimore City, weld manhole/handhole numbers to each cover. The numbering system shall be approved by the MTA and the Baltimore City prior to procuring manholes/handholes.

C. Install a ground rod in each manhole so that 8 inches of the ground rod protrudes above concrete floor and seal around ground rod with grout finished to match floor. Bond ground rod, by exothermic weld, to cable supports and all other metallic components with #1/0 AWG bare copper wire.

D. Field-apply 2 coats of concrete sealer to each exterior surface of the around the duct penetrations, conduit penetrations, frame, and field joints. Sealer shall be applied in accordance with the manufacturer's recommendations and must be of high quality to prevent water entry.

E. Penetrations around manhole/handhole conduits shall be sealed around all duct bank openings with approved non-shrink grout and waterproofing sealer.

3.04 INSTALLATION OF CONDUITS AND DUCTBANKS:

A. Direct buried or embedded conduit runs shall be non-metallic Schedule 40.

B. Conduits installed below grade shall be concrete encased unless otherwise indicated.

C. Conduit runs under tracks, platforms, parking lots, or roadways shall be encased in concrete.

D. Concrete encased conduits shall have three (3) inches minimum cover on all sides, unless otherwise indicated.

E. Buried or embedded conduits minimum size shall be one (1) inch.

F. Buried conduits shall be installed twenty-four (24) inches below finished grade unless otherwise indicated.

G. Buried conduits under tracks, roadways, and parking lots shall be installed thirty-six (36) inches (minimum) below finished grade, unless otherwise noted.

H. All conduit transitions from buried/embedded conduit to exposed conduit shall change to PVC coated rigid galvanized steel prior to leaving conduit. Minimum length of shall be eighteen (18) inches straight conduit or conduit elbow. Both shall be furnished and installed with a coated threaded coupling for the transition to exposed conduit.

I. All conduits and ductbanks shall be marked with appropriate underground detectable warning tape prior to completion of backfill and compaction at depth indicated on Contract Documents.

J. Conduit spacers shall be placed at 5 ft. intervals on center.

K. For concrete-encased ductbanks, the concrete shall completely encase the ductbank without disturbing its alignment or damaging the conduits.

L. Conduit terminations at manholes, handholes and hand boxes shall be fitted with end bells flush with finished surface.

M. At all stages of the work, the Contractor shall exercise care to prevent foreign material from entering the ducts. Each conduit shall be cleaned and tested by pulling a mandrel. Contractor shall give the MTA 24 hours notice prior to the cleaning.

N. Ductbanks connecting to manholes/handholes or underground structures shall be flared to have an enlarged cross-section at the manhole opening dimensions by less than 12 inches in each direction. The perimeter of the duct bank opening in the underground structure shall flared towards the inside or keyed to provide a positive interlock between the duct bank and the wall of the structure. Vibrators shall be used when this portion of the envelope is poured to assure a seal between the envelope and the wall of the structure.

O. Ductbanks connections to existing manholes/handholes or underground structures, break the structure wall out to the dimensions required and preserve the steel in the structure wall. Cut the steel and extend into the duct bank envelope. Chip the perimeter surface of the duct bank opening to form a key or flared surface, providing a positive connection with the duct bank envelope.

P. Where connections to existing ductbanks are indicated, excavate the banks to the maximum depth necessary. The banks shall be cut off and loose

concrete removed from the conduits before new concrete-encased ducts are installed. A reinforced concrete collar, poured monolithically with the new duct bank, shall be provided to take the shear at the joint of the duct banks.

Q. Partially completed ductbanks or during construction wherever a construction joint is necessary in a duct bank, prevent debris such as mud, sand, and dirt from entering the ducts by providing suitable conduit plugs. Fit concrete envelope of a partially completed duct bank with reinforcing steel extending a minimum of 24 inches back into the envelope and a minimum of 24 inches beyond the end of the envelope. Provide one No. 4 bar in each corner, 3 inches from the edge of the envelope. Secure corner bars with two No. 3 ties, spaced approximately 4 inches apart. Restrain reinforcing assembly from moving during concrete pouring.

R. Ductbanks and conduits shall slope down from building wall entry to prevent entry of water.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. 3” buried PVC conduit will be measured by the linear foot, installed in place with all backfill and surface restoration complete.

B. All other work required under this Section will not be measured for payment

4.02 PAYMENT:

A. 3” buried PVC conduit will be paid for at the contract unit price, installed in place with all backfill and surface restoration complete.

B. All costs in connection with all other work required under this Section will not be paid for directly, but will be considered incidental to the items of work to which it pertains.

END OF SECTION

SECTION 16289

TRANSIENT VOLTAGE SUPPRESSION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes TVSSs for low-voltage power, control, and communication equipment.

1.03 DEFINITIONS

A. ATS: Acceptance Testing Specifications.

B. SVR: Suppressed voltage rating.

C. TVSS: Transient voltage surge suppressor.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating weights, operating characteristics, furnished specialties, and accessories (CDRL).

B. Product Certificates (CDRL): For transient voltage suppression devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449.

C. Qualification Data (CDRL): For testing agency.

D. Field quality-control test reports, including the following (CDRL):

1. Test procedures used.
2. Test results that comply with requirements.

3. Failed test results and corrective action taken to achieve requirements.

E. Operation and Maintenance Data (CDRL): For transient voltage suppression devices to include in emergency, operation, and maintenance manuals.

F. Warranties (CDRL): Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain suppression devices and accessories through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with IEEE C62.41, "IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits," and test devices according to IEEE C62.45, "IEEE Guide on Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits."

D. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices."

E. Comply with UL 1283, "Electromagnetic Interference Filters," and UL 1449, "Transient Voltage Surge Suppressors."

1.06 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Administration or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Engineer not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Engineer's written permission.

B. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Temperature: 30 to 120 deg F (0 to 50 deg C).
3. Humidity: 0 to 85 percent, noncondensing.
4. Altitude: Less than 20,000 feet (6090 m) above sea level.

1.07 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

B. Special Warranty for Cord-Connected, Plug-in Surge Suppressors: Manufacturer's standard form in which manufacturer agrees to repair or replace electronic equipment connected to circuits protected by surge suppressors.

1.09 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Replaceable Protection Modules: One of each size and type installed.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. General Electric Company.
2. LEA International.
3. Siemens Energy & Automation, Inc.
4. Square D; Schneider Electric.
5. Tycor; Cutler-Hammer, Inc.
6. United Power Corporation.
7. Phoenix Contact.
8. Control Concepts Corp.

2.02 PANELBOARD SUPPRESSORS

A. Surge Protection Device Description: Non-modular, sine-wave-tracking type with the following features and accessories:

1. LED indicator lights for power and protection status.
2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.

B. Surge Protection Device Description: Modular design with field-replaceable modules, sign-wave-tracking type with the following features and accessories:

1. Fuses, rated at 200-kA interrupting capacity.
2. Fabrication using bolted compression lugs for internal wiring.
3. Integral disconnect switch.
4. Redundant suppression circuits.
5. Redundant replaceable modules.
6. Arrangement with wire connections to phase buses, neutral bus, and ground bus.
7. LED indicator lights for power and protection status.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. One set of dry contacts rated at 5 A and 250-V, ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.
10. Surge-event operations counter.

C. Peak Single-Impulse Surge Current Rating: 65 kA per phase.

D. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 208Y/120, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120.
2. Line to Ground: 400 V for 208Y/120.
3. Neutral to Ground: 400 V for 208Y/120.

E. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

2.03 SUPPRESSORS FOR ELECTRONIC-GRADE PANELBOARDS

A. Surge Protection Device Description: Sine-wave-tracking type, panel-mounted design with the following features and accessories:

1. LED indicator lights for power and protection status.

2. Audible alarm, with silencing switch, to indicate when protection has failed.
3. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status.
4. Arrangement with wire connections to phase buses, neutral bus, and ground bus.

B. Peak Single-Impulse Surge Current Rating: 65 kA per phase.

C. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 208Y/120, 3-phase, 4-wire circuits shall be as follows:

1. Line to Neutral: 400 V for 208Y/120.
2. Line to Ground: 400 V for 208Y/120.
3. Neutral to Ground: 400 V for 208Y/120.

D. Protection modes and UL 1449 SVR for 240/120-V, single-phase, 3-wire circuits shall be as follows:

1. Line to Neutral: 400 V.
2. Line to Ground: 400 V.
3. Neutral to Ground: 400 V.

2.04 PLUG-IN SURGE SUPPRESSORS

A. Description: Non-modular, plug-in suppressors with at least four 15-A, 120-V ac, NEMA WD 6, Configuration 15-15R receptacles, suitable to plug into a NEMA WD 6, Configuration 15-15R receptacle; with the following features and accessories:

1. LED indicator lights for power and protection status.
2. LED indicator lights for reverse polarity and open outlet ground.
3. Circuit breaker and thermal fusing. Unit continues to supply power if protection is lost.
4. Close-coupled direct plug-in.
5. Rocker-type on-off switch, illuminated when in the on position.
6. One RJ11/12C telephone line protector, suitable for modem connection. Maximum clamping voltage 220 peak on pins No. 3 and No. 4.

B. Peak Single-Impulse Surge Current Rating: 13 kA per phase.

C. Protection modes and UL 1449 SVR shall be as follows:

1. Line to Neutral: 475 V.
2. Line to Ground: 475 V.
3. Neutral to Ground: 475 V.

2.05 EXTERNALLY MOUNTED SUPPRESSORS

A. Protection modes and UL 1449 SVR for grounded wye circuits with voltages of 480Y/277, 3 phase, 4 wire circuits shall be as follows:

1. Line to Neutral: 800 V for 480Y/277 volts
2. Line to Ground: 800V for 480Y/277 volts.
3. Neutral to Ground: 800V for 480Y/277 volts.

B. Protection modes and UL 1449 SVR voltage of 480 volts, 3 phase, 3 wire delta circuits shall be as follows:

1. Line to Neutral: 2000V for 480 volts
2. Line to Ground: 2000V for 480 volts.

2.06 SOLID STATE ELECTRONICS

A. See Section 17195-2.10.

2.07 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.01 INSTALLATION OF SURGE PROTECTION DEVICES

A. Install devices for panelboard and auxiliary panels with conductors or buses between suppressor and points of attachment as short and straight as possible. Do not exceed manufacturer's recommended lead length. Do not bond neutral and ground.

3.02 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect panelboards, control terminals to their sources until surge protection devices are installed and connected.

3.03 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports:

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

B. Remove and replace malfunctioning units and retest as specified above.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Administration's maintenance personnel to adjust, operate, and maintain transient voltage suppression devices.

PART 4 :MEASUREMENT AND PAYMENT

4.01 GENERAL

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 16700

SITE SURVEY AND CERTIFICATION

PART 1: GENERAL

1.01 DESCRIPTION:

A. The Administration assumes that the project work site has adequate work areas for the installation of the proposed system. However, site reviews and surveys must be conducted for the possibility that there may be physical conditions that could restrict or bind the physical configuration, performance, or other characteristics of the to be installed system. Therefore, the burden of site review, surveys, preparation, and certification shall remain entirely a responsibility of the Contractor.

B. The MTA Project Manager cannot emphasize strongly enough the importance of good site planning prior to installation of the proposed system. Accordingly, before site certification is provided to the Administration in accordance with these Specifications, the Contractor is advised to read carefully all environmental and installation requirements as addressed in various sections of these Specifications.

1.02 SUBMITTALS:

A. The following documents are required to be submitted by the Contractor (CDRL):

1. Site Survey Report - to be submitted in accordance with the Contractor's schedule so as not to delay the completion of system design.

2. Site Certification - to be submitted in accordance with the Contractor's schedule so as not to delay the completion of system design.

B. Routine site preparation work should be described by the Contractor in the Site Survey Report. Any <u>unusual</u> conditions discovered by the Contractor, which may require corrective action <u>by the Administration</u> shall be made known to the MTA Project Manager in writing as part of the Site Survey Report.

PART 2: PRODUCTS

2.01 SITE SURVEY:

A. The Contractor shall survey the existing yard tracks and existing equipment in the vicinity of the new pushbuttons and wheel detectors, and all existing cable trough to be used for new cables. This means that at a minimum, the Contractor shall inspect to collect sufficient and adequate data to analyze the condition of each system/sub-system that could impact his design and installation.

B. The Contractor's survey shall examine and analyze cabling and/or conduit requirements along with cable trough fill, CIH room spaces, electromagnetic interference, temperature, cleanliness, moisture, and any other parameter that should be monitored and/or controlled to ensure proper operation of the all systems/sub-systems.

C. The Contractor shall identify the exact location where each wheel detector and pushbutton foundation will be located based on criteria provided in the contract drawings.

D. The Contractor shall be responsible for investigating the site conditions that may affect installation, reliable performance and code compliance for electrical and data cables. Cable splices shall not be permitted and all data cables shall be properly grounded. All electrical and civil construction work shall conform to any applicable City of Baltimore standard specifications as well as applicable local building codes. All electrical work shall conform to NEC, NEMA, and IEEE standards, where applicable.

E. A written report of the Contractor's site survey shall be prepared by the Contractor and discussed with the Administration within six days after receipt of the report.

2.02 CONTRACTOR SITE CERTIFICATION:

A. Contractor certification that the <u>existing conditions</u> of the work areas do not pose a threat to orderly installation and normal operation of the proposed system/sub-systems as required by these Specifications.

B. The certification required by this paragraph shall accompany the site survey report required in Article 2.01. In the event that the Contractor shall not be able to make certification within the time required by this Specification, the Contractor shall submit with the site survey, a brief letter of explanation as an interim report until certification is provided. Problems encountered and a summary of actions that the Contractor has undertaken in order to achieve site certification shall be fully explained in any interim report. Any interim report shall also advise the MTA Project Manager of the date when

the Contractor anticipates submitting the required site certification documentation.

PART 3: EXECUTION

3.01 SITE SURVEY AND CERTIFICATION:

A. The Contractor shall conduct the system-wide site survey and complete all site survey documentation and submit the required reports and certifications to the Administration specified herein and elsewhere in the specifications.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 16790

SPARE PARTS AND TEST EQUIPMENT

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes the requirements to be bid as part of this Contract. Requirements outlined in this Section are for the provision of a recommended spares list to be used by the Administration in completing its spares inventory.

1.02 QUALITY CONTROL:

See Section 01450.

1.03 SUBMITTALS:

Unless otherwise specified, all submittals shall be in accordance with Section 01300.

PART 2: PRODUCTS

2.01 GENERAL:

A. All spare items shall be identical to the equivalent installed item and shall meet all requirements of the appropriate sections of these Specifications.

2.02 RECOMMENDED SPARE PARTS LIST:

A. The Contractor shall develop a list of recommended spare parts and submit to the Administration immediately following the FDR (CDRL). All spares parts shall be approved by the Administration.

B. The quantities in the list shall be as recommended by the Contractor for two years of revenue service.

C. The Spare Parts List shall include the following information for each part:

1. Supplier and manufacturers part number;

2. Name, address and telephone number of supplier or manufacturer;

3. Name, address and telephone number of distributor (if applicable)

4. Nomenclature (description);

5. Assignment (type of assembly);

6. Drawing reference number;

7. Lead time for reorder;

8. Frequency and reasons for replacement based on records; and

9. Each part or component shall be identified as being part of next larger assembly or subassembly.

10. Unit price

D. Unit prices for each type of spare part shall be calculated using actual purchase prices with mark-ups for materials as defined in SGP-4.03 for purchased items or standard sell prices for items manufactured by the Contractor. Back-up in the form of copies of purchase orders or published price lists will be required.

2.03 RECOMMENDED TEST EQUIPMENT LIST:

A. The Contractor shall develop a list of recommended specialized test equipment. All test equipment shall be approved by the Administration.

B. Test equipment shall include any software utilities required to see, revise and otherwise maintain the PLC and Maintenance Panel software and shall be the same tools utilized by the Contractor to develop the PLC and Maintenance Panel software.

C. The Test Equipment List shall include the following information for each item:

1. Supplier and manufacturers part number;

2. Name and address of supplier or manufacturer;

3. Nomenclature (description);

4. Assignment (type of assembly);

5. Unit price

D. Unit prices for each piece of test equipment shall be calculated using actual purchase prices with mark-ups for materials as defined in SGP-4.03 for purchased items or standard sell prices for items manufactured by the Contractor. Back-up in the form of copies of purchase orders or published price lists will be required.

PART 3: EXECUTION

3.01 DELIVERY:

A. The Contractor shall deliver spare parts of the type and quantity in the approved recommended spare parts list and two sets of special test equipment to a location in the Baltimore area as directed by the Administration. Clearly mark with manufacturer's part and/or style number.

B. The Contractor shall unload and store all items neatly in an MTA facility as directed by the Administration.

C. The Contractor shall complete delivery and storage for all test equipment no earlier that 30 days prior to and no later than the completion of the FAIT.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Spare Parts and Special Test Equipment will be measured as a lump sum when delivered to the designated MTA facility using the approved unit prices from the approved lists of Recommended Spare Parts and Recommended Test Equipment.

4.02 PAYMENT:

A. All costs associated with the provision of Spare Parts and Special Test Equipment will be paid for directly, as a part of the Contract lump sum price from the Spare parts and Special test equipment allowance when the Spare Parts and Special Test Equipment are delivered to the Administration. The Contractor will only be paid the approved costs of the actual items delivered.

END OF SECTION

SECTION 17003

CONFIGURATION MANAGEMENT

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies requirements for the Contractor's Configuration Management Program, which includes planning, identification, definition, implementation, control, and accountability for the proposed systems.

1.02 CONFIGURATION MANAGEMENT PROGRAM:

A. Maintain and make available to the Administration accurate and current configuration records throughout the period of performance of the Contract and for a 3-year period after final Contract payment.

B. Do not procure nor produce any item, product, hardware or software until such items have been approved by the Administration.

C. All items, beginning with the lowest level of repair or replacement, identified by the same part number shall have the same physical and functional characteristics, be equivalent in performance and durability, and be interchangeable without alteration to themselves or associated items, other than normal field adjustments. An item shall not be considered interchangeable if it requires modification for fit or performance. Old and new configuration items that require segregation shall be identified either by a new drawing number or a dash number added to the original drawing.

D. Hardware Identification: Mark all hardware components to the lowest level of repair and replacement with part number identification. The hardware identification marking shall coincide with officially released engineering data. Nameplates on major equipment items shall provide space for Administration numbers to be added by Contractor at the direction of the Administration. Serialization is required on each item of equipment delivered unless otherwise directed by the Administration. Assign an individual serial number in a numerical sequence established for the type or model series equipment being supplied. Do not use duplicate serial numbers within a type or model series.

E. Change Control: These Specifications identify the Procurement Baseline for this proposed system. Changes to the Procurement Baseline after acceptance of products or system designs by the Administration shall be controlled by the processing of Engineering Change Proposals (ECP's) in accordance with the procedures described herein. All ECP's shall be reviewed by the Contractor's organization responsible for configuration

control for total impact evaluation prior to recommendation and submittal to the Administration for review and approval.

F. Classification of Changes:

1. A proposed engineering change to any part, assembly, or equipment item for the Supplier's product shall be designated as a Class I change when one or more of the following is affected.

   a. Form, fit, and functional interchangeability.

   b. Reliability and maintainability.

   c. Weight or balance (where it is a factor).

   d. Administration furnished equipment.

   e. Safety.

   f. Electromagnetic interference characteristics.

   g. Delivered product (retrofit).

   h. Delivered training, operation, or maintenance manuals (where additional Contract funds are required to revise manuals).

   i. Sources of repairable items (source control drawings).

   j. Schedules or deliverables.

   k. Initial provisioning.

   l. Performance of equipment.

   m. Training.

2. A proposed change to computer software shall be designated as a Class I change when one or more of the following factors is affected:

   a. Function, performance, including reliability, maintainability, correctness, efficiency, flexibility, testability, usability, and outside tolerance.

   b. Interface characteristics.

   c. Cost.

d. Schedules.

e. Administration furnished equipment.

f. Safety.

g. Skill levels, training or human engineering design.

3. Any engineering change not affecting form, fit, function, or interchangeability, nor falling within the preceding definition of a Class I change shall be designated as a Class II change. Some examples of Class II changes are correction and clarification of documents and drawings, substituting alternative materials or hardware, and those changes which do not affect the preceding listed Class I factors.

G. Accountability: Maintain records such that configuration of any items being delivered shall be definable in terms of its component part numbers. Account for differences between the as-built configuration and engineering released documentation. Record status of change approvals and incorporation at each point in product development, test, production, or operational usage. Maintain a serialization and configuration record. Maintain the status of interface specifications, control documents, and plans. Maintain status of software once a baseline has been defined.

H. Engineering Change Proposal (ECP):

1. Process each Class I change as an ECP and submit to the Administration for approval prior to initiating any implementation action (CDRL). Any action or cost necessary to correct problems in the product or documentation arising from Contractor's misclassification shall be borne by the Contractor. Contractor shall also classify and control changes originating from subcontractors. Submit 6 copies of the ECP to the Administration accompanied by technical documentation and the cost information necessary to fully evaluate the change.

2. Report all Class I changes which affect safety immediately. Identify the change by ECP number if reported verbally, and confirm the change in writing to the Administration within 24 hours. Class II ECP's shall be submitted to the Administration for information (CDRL).

I. Design Reviews and Audits:

1. Design reviews and audits shall be conducted jointly by the Administration and the Contractor. In all cases, approval by the

Administration shall not constitute relief from contractual obligations. Submit all documentation, plans, and design data for the reviews and audits at least 10 working days prior to the date of the review (CDRL). Software reviews and audit shall be in accordance with ANSI/IEEE Standard 730 (latest revision).

2. Preliminary Design Review (PDR): Evaluate the design progress, technical adequacy of the design and hardware approach, determine their compatibility with the performance requirements and interfaces of the Contract and the schedule to complete all contract work as stated in Specification section 01110, Summary of Work. The review shall be held on a mutually agreeable date consistent with the Contractor's design schedule at the Administration's facility.

3. Final Design Review (FDR): Conduct the review when detail design of all items is essentially complete and the production drawings are ready for release. Determine that detail design of the system element under review will satisfy the design requirements established in the Contract Specifications and to establish the exact interface relationships between the item and other items of equipment and facilities. The review shall be held on mutually agreeable dates consistent with the Contractor's design schedule at the Administration's facility unless another location is approved by the Administration.

1.03 SUBMITTALS:

Unless otherwise specified, all submittals shall be in accordance with Section 01300 and Article 2.03 herein.

A. Configuration Management Plan (CDRL).

B. Complete set of final (as-built) drawings, as specified in other sections specifying the various equipment, with all changes incorporated thereon (CDRL).

C. Design review and audit documentation (CDRL).

D. Contract Data Requirements List (CDRL).

E. Design Documents to complete all work sepcified in Specification Section 01110, Summary of Work (CDRL).

PART 2: PRODUCTS

2.01 CONFIGURATION MANAGEMENT PLAN (CDRL):

A. Prepare and submit to the Administration a Configuration Management Plan which covers hardware and software. Contractor's Standards Plan may be submitted for approval if it meets the stated criteria.

2.02 CONTRACT DATA REQUIREMENTS LIST (CDRL):

A. Prepare and submit a comprehensive Contract Data Requirements List. The CDRL submitted by Contractor shall delineate a serial number, title of the CDRL, due date, number of copies required, reference specification section, frequency required, and whether Administration approval is required.

2.03 DRAWINGS AND DESIGN EVALUATION DATA:

A. The Contractor shall submit drawings and design evaluation data for all design, manufacutring, procurement and installation work:

B. The above plans shall be used to replace the current plans due to changes under this contract. Existing plans shall be available upon request from the Administration for Contractor's reference.

C. Drawing Quality and Updating: Drawings shall be of a quality where every line, number, letter and symbol is clearly legible. Contractor shall update each drawing, incorporating all outstanding approved changes, at least once every 30 days. In no event shall more than 5 approved changes be accumulated against a drawing without incorporation, irrespective of its scheduled update. Changes to drawings shall be incorporated sequentially. Copies of all updated drawings, which were submitted to the Administration in earlier revision, shall be resubmitted in the original quantity and format.

D. Calculations: Furnish calculations and other required data on standard 8.5 by 11 inch sheets, printed on one side only. Each sheet shall bear the following: Contract Name and Number; Title and Number of Pages; Data and Revision Status.

E. Drawing Approvals: If approved by the Administration, a copy of each drawing will be identified as having received such approval by being so stamped and dated. Drawings stamped "not approved" or "exceptions noted" and with required corrections shown will be returned to Contractor for correction and re-submittal. Re-submittals will be handled in the same manner as first submittals.

F. System cable plans:. All cables shall be identified with numbers of conductors and size and nomenclature of the equipment to which the cable is connected.

2.04 STAGING PLAN

A. Prepare and submit a staging plan to include details on where and how the material will be stored and/or temporarily setup prior to final installation.

PART 3: EXECUTION

3.01 PROGRAM PLANS:

A. Implement and maintain the plans during all phases of the Contract.

3.02 CONTRACT DATA REQUIREMENTS LIST:

A. Implement and maintain the list to plan, schedule and track status of all submittals required by the Contract.

3.03 REVIEW AND AUDITS:

A. Conduct reviews and audits in accordance with specified requirements.

PART 4: MEASUREMENT AND PAYMENT

4.01 CONFIGURATION MANAGEMENT:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17025

SYSTEMS ASSURANCE

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies the general requirements for the Contractor's Systems Assurance Program Plan (SAPP) including System Safety Engineering, Reliability Engineering, and Maintainability Engineering. Requirements for Human Factors (Human Engineering) and Quality Assurance, although not addressed directly herein, are integral parts of System Assurance and are to be considered in the development of the SAPP. The contractor shall develop and implement a Systems Assurance Program Plan (SAPP), encompassing system safety, reliability, and maintainability engineering. The systems assurance requirements shall apply to all systems, subsystems and assemblies, software, hardware and firmware provided under the scope of this contract and all interfaces of the North Avenue Yard Route Pushbutton System project. The requirements apply to all suppliers and subcontractors during all phases of the work including design, manufacture, construction, installation, testing, in-service support, warranty, retrofits, and field modifications.

The systems assurance requirements shall be implemented on systems, subsystems, assemblies and interfaces contained in these contract documents to the extent covered under Contractor's scope. System elements and subsystems include but are not limited to the microprocessor interlocking system, control panels, wheel detectors and interfaces with existing circuits. Interface requirements shall encompass hardware, software, firmware, man/machine interfaces, operations, maintenance, training, rules and procedures.

B. APPLICABLE GUIDELINES: Develop and implement the SAPP in accordance with the latest revision at time of award of Contract of the following documents:

1. Federal Transit Administration (FTA) Hazard Analysis Guidelines for Transit Projects (2000).

2. Federal Transit Administration (FTA) Handbook for Transit Safety and Security Certification (2002).

3. Manual for the Development of Rail Transit System Safety Program Plans: APTA Rail Safety Audit Program, 1999.

4. Maryland Transit Administration (MTA) System Safety Program Plan.

5. National Fire Protection Association (NFPA) Standards.

6. APTA Standard Glossary of Terms of System Safety.

C. Objectives and Criteria:

1. The primary objective of the SAPP shall be to optimize the system safety, reliability, and maintainability characteristics of the systems, subsystems equipment and assemblies provided under this contract, hardware, software and firmware and their interfaces by:

   a. Eliminating critical and catastrophic hazards, and reducing unacceptable and undesirable risk (defined by severity and probability of occurrence) to an acceptable level, based on risk acceptance criteria provided herein.

   b. Providing a high degree of reliability.

   c. Minimizing downtime during maintenance and malfunctions.

2. A secondary objective of the SAPP shall be to minimize the magnitude and seriousness of those events or malfunctions which could result in injury to patrons or personnel and damage to equipment or property, but which cannot be completely eliminated.

3. Formulate and document criteria to satisfy the requirements for systems assurance through the design, construction, manufacture, installation, testing, commissioning, migration, and cutover phases of the Contract.

D. During design and installation of the systems, employ the objectives, requirements, criteria, and methodology stated in the SAPP to accomplish the goals of System Safety.

E. Apply scientific and engineering principles to identify and analyze potential hazards and to recommend the necessary action to eliminate, control, or minimize the hazards.

F. List of Abbreviations: The following abbreviations are used in this section:

APTA – American Public Transportation Association
CDRL – Contract Data Requirements List
CIL – Certifiable Items List
CSCS – Central Supervisory Control System
CSS – Central Supervisory Station

FACP – Fire Alarm Control Panel
FCC – Fire Command Center
FMEA – Failure Modes and Effects Analysis
FMP – Fire Management Panel
FMS – Fire Management System
FTA – Federal Transit Administration
MIL-HDBK – Military Handbook
MIL-STD – Military Standard
MFSFSM – Metro Fire, Security & Facility Systems Modernization
MTA – Maryland Transit Administration
MTBF – Mean Time between Failures
MTTR – Mean Time to Repair
NFPA – National Fire Protection Association
OCC – Operations Control Center
OHA – Operating Hazard Analysis
PHA – Preliminary Hazard Analysis
RDT – Reliability Demonstration Test
RPP – Reliability Program Plan
SAPP – Systems Assurance Program Plan
SCADA – Supervisory Control and Data Acquisition (SCADA)
SCIL – Safety Critical Items List
SLAN – Station Local Area Network
SOP – Standard Operating Procedure
TP – Traction Power

1.02 SUBMITTALS:

Unless otherwise specified, all submittals shall be in accordance with submittal requirements specified elsewhere in these documents.

A. Submit a SAPP for approval and revise as necessary throughout the project (CDRL). Elements addressed in the SAPP shall require separate submittals as follows:

1. Failure Data Collection System (CDRL).

2. As part of the monthly Progress Reports (CDRL) specified elsewhere in these documents, submit the status of system safety, reliability, availability, and maintainability activities, based on the information gathered on the milestone charts specified in the SAPP.

3. Final Acceptance Audit (CDRL).

4. Completed and Signed Safety Certification Checklists and Safety Certification Report (CDRL)

B. Submit System Safety Program Plan (SSPP) (CDRL)

C. Submit the Safety Critical Items List (CDRL).

D. Submit Safety Certification Program Plan encompassing each system and location covered under the scope of this contract (CDRL).

E. Submit completed and signed safety certification checklists and applicable Certificates of Compliance for all certifiable items list (CIL), verifying completion of design, construction and testing of safety- and security-related system elements and subsystems, assemblies, software and hardware and all documentation for all locations, in accordance with the scope of this contract. (CDRL)

F. Upon the Engineer's approval, existing analyses and test data which are properly documented and verifiable may be submitted in lieu of select analyses and tests for equipment and applications which are identical with the Engineer's approval, or manifestly similar to those required under this contract. Existing analyses shall contain the same data required by analyses guidelines specified herein, presented in a neat, concise, and logical manner.

G. Input to Training Program: Include information on system safety methods and procedures, protective devices, and emergency equipment and provide input from safety analyses in the form of warnings and caution statements into the training program and into the operating and maintenance/service manuals, for systems, subsystems, equipment hardware, software and firmware provided under this contract.

PART 2: PRODUCTS

2.01 SYSTEMS ASSURANCE PROGRAM PLAN (SAPP):

A. Produce a SAPP which integrates the system assurance elements in all phases of this Contract. Incorporate a disciplined approach to evaluate all system designs with regard to system safety, reliability and maintainability, with the objective of prescribing corrective action in a timely and cost effective manner.

B. Clearly define the responsibilities and functions of personnel directly associated with systems assurance policies and implementation of the program. Describe the systems assurance organization. Identify and formally document authority delegated to the systems assurance organization and the relationship between that organization and all other organizational components.

C. Final Acceptance Audit: Conduct a final acceptance audit at the completion of all demonstration testing to establish the operational baseline of the system. The audit shall include a detailed review and analysis of the test

results. Document the results of the audit and assign action items to resolve deficiencies. Provide all support equipment and services required by the test plan.

2.02 SYSTEM SAFETY PROGRAM PLAN:

Include a detailed System Safety Program Plan as part of the SAPP, including:

A. Task listing and time phasing of each task.

B. Organization and responsibility of key personnel.

C. Procedures to accomplish the system safety tasks, including provisions to:

1. Correct system safety deficiencies noted during the design phase as soon as possible, but not later than system design acceptance.

2. Evaluate system design and design changes.

3. Take immediate corrective actions to prevent personal injury or system damage when a Category I or II hazard is identified, and take action to reduce identified risk (defined as the combination of hazard severity and probability) from Unacceptable and Undesirable risk to a lower risk as defined herein.

4. While Unacceptable risk shall be immediately eliminated, designed-out and controlled to an acceptable level before design acceptance, Undesirable risk shall be prioritized for corrective action based on cost benefit considerations giving precedence to those hazards with the highest risk reduction potential with the most cost-effective mitigation measures.

5. Implement safety changes, which are Contractor initiated and approved by the Administration, and those initiated by the Administration, which fall within the Contractor's area of responsibility.

6. Coordinate the activities of the Contractor's system safety program with the overall MTA System Safety Program.

D. System safety criteria shall be in consonance with the MTA system safety criteria, MTA design criteria and specified guidelines under this contract. Implement the approved criteria throughout all aspects of design development, test, delivery, installation, and maintenance. The criteria shall include requirements for the following:

1. Design Safety: Employment of system safety techniques that optimize the design to minimize or control hazards identified by

failure analyses. Coordination to avoid potential hazards resulting from complexity of design. Maintenance of standardization of design by use of proven standards of the transit industry and applicable regulatory codes.

2. Potential Failures: Ensure a single-point failure in a dynamic system will not result in an unacceptable or undesirable hazard risk. Ensure elimination or minimization of the hazards by design, except in specific cases where high reliability, failsafe items may be used, based upon a properly documented past history of low failure rate, if approved by the Administration after submission of the history of these items. Control of potential failures of less than undesirable risk classification through use of safety devices and approved operating or maintenance procedures.

3. Redundancy: Incorporation of redundant circuits and components as specified.

4. Human Factors: Prevent/minimize human error(s) when responding to field and operational conditions by eliminating conflicting or ambiguous alarms, and status indications; conflicting or ambiguous instructions; lengthy or complicated instructions; inherent design errors/problems; unclear or incomplete supporting hardware and software documentation.

E. Safety Principles: The following safety principles shall be implemented by the Contractor in the design and operational concepts of the systems, subsystems, functions, assemblies and interfaces, to the extent covered under Contractor's scope in these contract, within the dynamic environment of the Baltimore Light Rail system:

1. When the systems are operating normally there shall be no unacceptable or undesirable hazard conditions.

2. There shall be no single-point failures or fault conditions in the wheel detector and vital circuit interface system that can result in an unacceptable or undesirable hazard condition.

3. If one failure of the wheel detector or vital system interface combined with a second failure can cause an unacceptable or undesirable hazard condition, the first failure shall be detected and the system shall achieve a known safe state before the second failure can occur.

4. Unacceptable hazards shall be eliminated by design.

5. Maintenance activities required to preserve or achieve risk levels shall be performed. Personnel qualifications required to adequately implement these activities shall also be identified.

F. Training: Include information on system safety methods and procedures, protective devices, and emergency equipment and provide input from safety analyses in the form of warnings and caution statements into the training program and into the operating and maintenance/service manuals, for systems, subsystems, equipment hardware, software and firmware provided under this contract.

2.03 RELIABILITY PROGRAM:

A. Prepare a description of the Contractor's reliability program as part of the SAPP, including:

1. Organization and responsibilities of key personnel.

2. Interfaces between reliability, maintainability, system safety, and other closely related programs, and support to efforts such as:

a. Logistic support and maintenance planning.

b. Design.

c. Quality assurance and quality control.

d. Standardization.

e. Systems engineering.

f. Personnel subsystem program (human engineering, life support, training, and personnel resources).

3. Provision for source selection, first article inspection, and surveillance of subcontractor's reliability activities.

4. Procedures and controls, including piece part selection and screening, manufacturing process controls, procurement controls, and test procedures, to be utilized during production to assure achievement of reliability requirements.

5. Provisions to evaluate operational and design changes for possible effects upon system reliability.

6. Description of methods Contractor will use to predict compliance with reliability goals.

2.04 MAINTAINABILITY PROGRAM:

A. Prepare a description of the Contractor's Maintainability Program as part of the SAPP, including:

1. Provisions for early fault detection and rapid fault isolation to the proper service level for minimization of costs and MTTR.

2. Provisions for simplification of fault detection, isolation, and repair so as to minimize the skill levels and training requirements for maintenance personnel by use of maintenance aids or test equipment.

3. Provisions for accessibility for maintenance tasks.

4. Provisions for reduction of the following: complexity of the maintenance, design-dictated maintenance activities and related costs, maintenance down-time and effects on system operation, maintenance costs, potential for maintenance error, and man/machine interface problems.

5. Provisions to evaluate operational and design changes for possible effects upon maintainability requirements.

2.05 SYSTEM SAFETY ANALYSES:

A. General: The contractor shall perform system safety analyses related to the wheel detectors and vital circuit interfaces to identify safety hazards, assess their risk as a function of hazard severity and probability of occurrence, and apply MTA-approved risk acceptance criteria for hazard mitigation and resolution.

B. Hazard Severity Definitions: Hazard severity categories are defined to provide a qualitative measure of the worst credible mishap resulting from personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure, malfunction, or fault condition, as follows:

1. Hazard Category I – Catastrophic: Operating conditions such that personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure, malfunction, or fault condition, may cause death, system loss or severe environmental damage.

2. Hazard Category II – Critical: Operating conditions such that personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure,

malfunction, or fault condition, may cause severe injury, severe occupational illness, or major system or environmental damage.

3. Hazard Category III – Marginal: Operating conditions such that personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure, malfunction, or fault condition, may cause minor injury, minor occupational illness, or minor system or environmental damage.

4. Hazard Category IV – Negligible: Operating conditions such that personnel error, environmental conditions, design inadequacies, procedural deficiencies, system, subsystem or component failure, malfunction, or fault condition, will result in less than minor injury, minor occupational illness, or less than minor system or environmental damage.

C. Hazard Probability Definitions: Hazard probability shall be described qualitatively in potential occurrences per units of time (per hour, per year, etc). A hazard probability may be derived from the analysis of transit system operating experience, evaluation of similar systems in identical or manifestly similar conditions, and from historical safety data of the systems at other transit systems. The probability rankings are defined as follows:

1. Probability Rank A – Frequent: Likely to occur frequently to an individual item. Continuously experienced in the entire contracted system.

2. Probability Rank B – Probable: Will occur several times in the life of an item. Will occur frequently in the entire contracted system.

3. Probability Rank C – Occasional: Likely to occur sometime in the life of an item. Will occur several times in the entire contracted system.

4. Probability Rank D – Remote: Unlikely but possible to occur in the life of an item. Unlikely but can be reasonably expected to occur in the entire contracted system.

5. Probability Rank E – Improbable: So unlikely is can be assumed occurrence may not be experienced in the life of an item. Unlikely but possible to occur in the entire contracted system.

D. Perform safety analyses to identify potentially hazardous conditions. Perform and document quantitative analyses as required to ensure that adequate safety consideration has been given. Apply system safety analyses to:

1. Evaluate alternatives.

2. Evaluate and verify safety requirements of the systems, subsystems and assemblies for the systems under the scope of this contract.

3. Evaluate the operation/emergency procedures and training requirements.

4. Provide visibility of relative safety and risk within system components.

E. Perform analyses of systems, subsystems and functions to identify potential system safety hazards in system elements, subsystems and assemblies, hardware and software and interfaces.

1. Perform analyses of interfaces between each system and operating and maintenance personnel.

2. Perform analyses of interfaces between each system and other systems that directly interface with it.

3. Perform analyses of potential human errors and fault conditions arising from operations and maintenance manuals.

F. In performing the required analyses, the depth of detail shall be dictated by hardware and software components, functions and modules called for in the final design, identified critical items, and unresolved potential failures of unacceptable and undesirable risk index. The following analyses shall be utilized:

1. Preliminary Hazard Analysis (PHA).

2. Operating Hazard Analysis (OHA).

G. These analyses shall be documented in general accordance with the Federal Transit Administration's (FTA's) Hazard Analysis Guidelines for Transit Projects. The contractor's analysis format shall be approved by the Administration.

H. Maintain a compilation of safety-critical items identified during the system safety analyses, in a safety critical items list (SCIL), which shall be maintained and updated by the contractor throughout the duration of the contract. Safety critical items shall consist of hazards with Unacceptable and Undesirable risk. The format of the SCIL shall be approved by the Administration. Document for approval any rationale in lieu of corrective action. Conduct a special review of unresolved critical items on the SCIL with the Administration.

I. Existing analyses and data which are properly documented and verifiable and which present the material in a neat, concise and logical manner may be submitted for equipment and applications that are identical or manifestly similar.

J. For each identified hazard, establish hazard severity category (I through IV), hazard probability ranking (A through E), and a combined hazard risk index reflecting the severity and probability ranking.

K. Apply risk assessment criteria to identified hazards based on the identified severity and probability of occurrence, to determine acceptance of the risk or the need for corrective action to further reduce the risk. The risk acceptance criteria shall conform to the Federal Transit Administration's (FTA's) Hazard Analysis Guidelines for Transit Projects and the following table:

TABLE A – HAZARD RISK ASSESSMENT MATRIX AND ACCEPTACE CRITERIA

	Severity			
	I	**II**	**III**	**IV**
Frequency of Occurrence	Catastrophic	Critical	Marginal	Negligible
(A) Frequent	**IA**	**IIA**	**IIIA**	**IVA**
(B) Probable	**IB**	**IIB**	**IIIB**	**IVB**
(C) Occasional	**IC**	**IIC**	**IIIC**	**IVC**
(D) Remote	**ID**	**IID**	**IIID**	**IVD**
(E) Improbable	**IE**	**IIE**	**IIIE**	**IVE**

Legend:	Hazard Risk Index	Acceptance Criteria
	IA, IB, IC, IIA, IIB, IIIA	Unacceptable
	ID, IIC, IID, IIIB, IIIC	Undesirable (decision required)
	IE, IIE, IIID, IIIE, IVA, IVB	Acceptable with review
	IVC, IVD, IVE	Acceptable without review

L. Analyze hazards which are identified as having an unacceptable or undesirable risk, using logic network analyses (such as fault tree) to determine effectiveness of corrective action. Unacceptable and undesirable risk shall be reduced to an acceptable level before design acceptance. Undesirable risk shall be mitigated on a priority basis using cost-benefit considerations and shall be approved by the Administration.

M. Hazards identified as "acceptable with review" may be accepted by the Administration in an "as-is" condition with no further corrective action. Alternatively, the Administration may require the Contractor to develop operating and maintenance procedures for periodic tests and inspections of the subject item to ensure an acceptable level of safety is maintained over the life of the system.

N. Hazards with combination of severity and probability IVC, IVD, IVE will be acceptable to the Administration.

2.06 SAFETY CERTIFICATION PROGRAM:

A. The contractor shall develop and implement a Safety Certification Program Plan in accordance with the Federal Transit Administration (FTA) Handbook for Transit Safety and Security Certification (2002). The Safety Certification process shall include, among others, the development and verification of implementation of safety (and security) related requirements compiled in two types of safety certification requirement checklists for certifiable items on this project at the following project phases, as follows:

1. Criteria Conformance Checklists, for the Contractor's design phase of the project. This checklist shall verify that the Contractor has incorporated into its final design all applicable MTA Safety (and Security) related Design Criteria and code requirements, standards and regulatory requirements mandated at the Federal, State and local level, including national standards such as the National Fire Protection Association (NFPA), building codes, and Underwriters Laboratory (UL) listing requirements.

2. Specifications Conformance Checklists, for the Contractor's project phases of construction, manufacture, installation, testing, commissioning, leading to use of the equipment in revenue service. The specifications conformance checklist shall document and verify that all safety (and security) related requirements in the contract documents have been met by the Contractor. The following program requirements shall also be included in the Specification Conformance Checklist:

   a. Safety Analysis and resolution of Safety Critical Items List (SCIL).

   b. Traceability Matrices showing how contract requirements were met by the contractor and subcontractors through design, analysis, construction, manufacture, installation and testing.

   c. Testing requirements addressing factory, acceptance, field, static, commissioning, dynamic, systemwide, integration and 30-day tests.

   d. Training

   e. Procedure Development.

B. The Contractor shall develop and submit to the Administration a Certifiable Items List (CIL) consisting of the safety certification requirements compiled at the Certifiable Element, sub-element and items. The CIL shall be based on system elements and sub elements encompassing safety (and security) related systems, subsystems, assemblies and interfaces, to the extent covered under Contractor's scope in the contract documents.

C. Early during the Contractor's design phase of the project, and in accordance with the Contractor's Safety Certification Program Plan, the Contractor shall submit to the Administration the initial Safety Certification requirement checklists of Criteria Conformance Checklist, encompassing and addressing the Certifiable Items List (CIL). The CIL shall consist of safety and security related system elements at each location under this contract. This checklist, in the Administration- approved format, shall be used by the Contractor to certify the Contractor has incorporated into its final design all applicable MTA Safety (and Security) related Design Criteria and code requirements, standards and regulatory requirements mandated at the Federal, State and local level, including national standards such as the National Fire Protection Association (NFPA), building codes, and Underwriters Laboratory (UL) listing requirements.

D. Early during the Contractor's Construction phase of the project, and in accordance with the Contractor's Safety Certification Program Plan, the Contractor shall submit to the Administration the initial Safety Certification requirement checklists of Specification Conformance Checklist, encompassing and addressing the Certifiable Items List (CIL).

E. Prior to revenue service and/or prior to any incremental opening of the system for revenue service, and in accordance with the Contractor's Safety Certification Program Plan, the Contractor shall submit to the Administration the completed, signed and verified Safety Certification Checklists, consisting of Criteria Conformance Checklists and Specifications Conformance Checklists for the Certifiable Items List (CIL) at all applicable locations. Included among the signed checklists and certifiable items shall be verification of successful completion of:

1. Safety Analyses and resolution of Safety Critical Items List (SCIL).

2. Traceability Matrices showing how contract requirements were met by the contractor and subcontractors through design, analysis, construction, manufacture, installation and testing.

3. Testing requirements addressing factory, acceptance, field, static, commissioning, dynamic, systemwide, integration and 30-day Operation tests.

4. Training

5. Procedure Development.

F. The safety certification checklists signed by the contractor shall be supported by documented evidence of Contractor's traceability matrices showing contactor has implemented the design criteria and contract documents requirements and complied with all safety related requirements in design, analysis, testing and verification, for each safety- and security related Certifiable Item on the checklists. The Contractor shall also produce signed Certificates of Compliance as required by the Safety Certification Program Plan. The Safety Certification shall ensure all systems, subsystems and assemblies, hardware and software, covered under this Contract have been designed, fabricated, installed and tested in accordance with all applicable codes, criteria, contract documents and are safe for revenue service.

G. The Criteria Conformance Checklists, and Specifications Conformance Checklists and all Certificates of Compliance prepared by the contractor shall be signed and dated by the Contractor's Representative to certify the requirements have been successfully met and compliance verified.

PART 3: EXECUTION

3.01 PROGRAM PLAN:

Implement and maintain the various aspects of the SAPP during design, construction, installation and testing phases of the Contract.

3.02 SYSTEM SAFETY ANALYSES:

Perform safety analyses, as specified, during the design phase of the Contract.

3.03 TEST AND VERIFICATION PLAN:

Implement the provisions of the test and verification plan during the design, installation, FIAT and 30-day operation testing period including initial revenue service testing of the equipment. Perform the tests in accordance with other sections in these documents, in an environment that simulates actual operation.

3.04 COORDINATION:

A. Design Impact: Closely coordinate the SAPP and results of system safety analyses with design disciplines, particularly as the results affect design and hardware development. Make recommendations for redesign or modifications to ensure compliance with specified requirements including, as required, installation of test points and built-in test capabilities, installation of in-service status display indicators to facilitate fault isolation

and test, utilization of high reliability parts with easy accessibility and quick disconnect connectors, and use of mechanical keying to reduce errors during installation.

B. Design Problems: Document instances where evaluation or analyses indicate an unresolved problem area, and formulate appropriate recommendations. Maintain records, which show that follow-up action has been taken to resolve the problem.

C. Design Reviews: Assure participation by the system assurance organization in all design reviews.

3.05 RECORDS MANAGEMENT:

Contractor shall maintain documentation of systems assurance throughout the design, and make it available for examination by the Administration.

3.06 DESIGN:

During consideration of precedence in the control of unacceptable and undesirable system hazards, take cognizance of human limitations as a design constraint. Take corrective action to eliminate or control unacceptable and undesirable hazards using the following order of precedence:

A. Design for Minimum Risk. Design, redesign or retrofit to eliminate (i.e., design out) the hazards through design selection. If an identified hazard cannot be eliminated, reduce the severity and/or probability of occurrence to an acceptable level. The contractor shall use fail-safe devices and principles in design, and incorporate high-reliability systems and components and use of redundancy in hardware and software design.

B. Safety Devices. Hazards that cannot be eliminated or controlled through design selection shall be controlled to an acceptable level through the use of fixed, automatic or other protective safety design features or devices. The contractor shall use safety devices such as interlock switches, protective enclosures and safety pins. The contractor shall ascertain that the operation of the safety device reduces the loss or risk and does not introduce an additional hazard. Safety devices shall also permit the system to continue to operate in a limited manner. The contractor shall make provisions for periodic functional checks of safety devices.

C. Warning Devices. When neither design nor safety devices can effectively eliminate or control an identified hazard, the contractor shall use devices to detect the condition and to generate an adequate warning signal to correct the hazard or provide for personnel remedial action. The contractor shall design warning signals and their application to minimize the probability of

incorrect personnel reaction to the signals and shall standardize warning systems within like types of systems.

D. Procedures and Training. Where it is not possible to eliminate or adequately control a hazard through design selection or use of safety and warning devices, the contractor shall use procedures and training to control the hazard. Special equipment operating procedures shall be implemented to reduce the probability of a hazardous event and a training program shall be conducted. The level of training required shall be based on the complexity of the task and minimum trainee qualifications contained in training requirements specified for the subject system element and element subsystem. Procedures may include the use of personal protective equipment. The contractor shall standardize precautionary notations in manuals. Safety critical tasks, duties and activities related to the system element/subsystem shall require certification of personnel proficiency. However, without specific written approval of the Administration, no warning, caution or other form of written advisory will be used as the only risk reduction method for Category I and II hazards.

PART 4: MEASUREMENT AND PAYMENT

4.01 SYSTEMS ASSURANCE:

A. No separate measurement shall be made for the work required under this Section.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110..

END OF SECTION

SECTION 17103

INTERFACE REQUIREMENTS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section describes the interface between Contractor-furnished equipment and existing North Avenue Yard equipment.

B. Contractor shall be responsible for design and development of the interface between Contractor-furnished equipment and existing North Avenue Yard equipment.

C. Contractor shall furnish all design, staging plans, labor, materials, tools, equipment and supplies necessary to provide interfaces that are functionally seamless.

D. Such interfaces shall be supplied between existing and new Non-Vital Request and Indication System and also between Contractor supplied equipment and equipment and installations provided by others.

1.02 QUALITY ASSURANCE: Comply with the requirements of Section 01450.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Interface Plan (CDRL).

B. Staging and Installation Plan (CDRL).

1.04 INTERFACES COMMON TO ALL SYSTEMS:

A. Parameters:

1. North Avenue yard signal equipment shall be capable of being operated, stored and maintained without impairment resulting from the addition of the Non-Vital Route Request and Indication System throughout the range of worst-case conditions as specified in these Specifications.

2. Contractor is advised that part of the work under this Contract is to be performed on the existing CLRL with Light Rail train operation.

B. Administration Interface:

1. Contractor will be permitted access to operating portions of the North Avenue Yard on a prearranged basis. Access requests must be submitted in writing, with at least 7 days notice, to the Administration.

   a. Access requirements will be provided by the Administration. These requirements will include scheduling, work staging, construction interfacing and the environment under which the work will be accomplished.

   b. Contractor shall attend weekly meetings with the Administration and describe his work plan for the next 2 weeks. These meetings will be used to effect coordination and to resolve issues.

2. Any installation or testing which affects existing light rail yard train operations must be done during the hours to be specified by the Administration and must be completed in sufficient time to allow for normal yard activity. It is Contractor's responsibility to supply sufficient competent employees and reserves to assure restoration of scheduled service within the allotted time. Contractor shall furnish all equipment such as, but not limited to flags, safety vests, lanterns, phones, and radios.

3. Any work crew interfacing with the existing CLRL operations shall have successfully completed Light Rail Roadway Worker protection training as outlined in the OFS SOW 105 G.

4. Work that does not affect yard operations may be performed, with the authorization of the Administration, during Light Rail operation hours. General Orders/Bulletins, as required, will be issued by the Administration. Contractor shall furnish such flagmen, watchmen or other employees as may be deemed necessary for safe and continuous operations at no additional cost. Detailed plans of Contractor's procedures, including an itemized time schedule and breakdown of the labor force shall be submitted to the Administration at least 10 working days prior to implementation. The Administration reserves the right to determine the number of necessary flagmen, based on Contractor's work plan.

5. The Administration will furnish LRVs, with operators, as appropriate, at no cost to the Contractor, for the Signal System

Integration Tests as specified in Section 17251.

6. Lighting and electric power, where not specifically provided by others, shall be provided by Contractor.

7. Cooperate with the Administration and respond within a period of 15 days following receipt of any request for information on behalf of the Administration. The Administration will be required to respond in a similar manner to requests from the Contractor.

C. Passenger Vehicle Interface:

1. The passenger vehicle dynamic profile will be provided to Contractor upon award of contract. For the purpose of pushbutton system design, on level tangent track a minimum clearance of 6 feet 3 inches from the track centerline to the rail side edge of installed wayside equipment extending above the top of rail shall be maintained, as shown in the contract documents. All locations shall be approved by the Administration.

D. Interface with Others: During this project, Contractor will be required to interface their work with other agencies and Administration contractors working on the project. It will be Contractor's responsibility to coordinate and schedule their work activities with the Administration to avoid conflicts.

E. Contractor shall assume total responsibility for the correction of any degradation in the performance of existing Administration systems or equipment, which results from any system or equipment interface installed by Contractor.

F. Contractor shall identify and submit an estimate of the required Administration's support needed during staging and cutover.

G. Pushbutton assemblies and signs shall, immediately after installation, be covered in a manner subject to the approval of the Administration, and remain covered until such time as they are placed in service or during test where applicable. Contractor shall cover in a similar manner, pushbutton assemblies and signs that have been removed from service.

H. Coordinate all interface work with the Administration.

I. Contractor shall be responsible for the protection of existing equipment and facilities while working on the system. It shall be the responsibility of Contractor to completely repair any equipment or facilities damaged while accomplishing the work at the contractors cost.

J. Contractor shall bear total liability and responsibility for all specified additions and changes to the Administrations systems.

PART 2: PRODUCTS

2.01 DOCUMENTATION:

A. Interface Plan:

1. Contractor shall submit an Interface Plan that covers logistics of the design and development of the interfaces between Contractor-furnished equipment and equipment and installations furnished by others. Plan shall include, but not limited to LRC, communication equipment rooms, relay/instrument housings, manholes and shall specify responsibility for providing and installing. Plan shall include interfaces with other contractors.

2. Contractor's Interface Plan shall ensure that interfaces are so designed that systems and subsystems function in concert when all elements are assembled.

3. Proposed changes to interfaces shall be subject to review and approval by the Administration, and contain requirements for implementation of both sides of the interface.

B. Interface Design Document:

1. Contractor shall submit an Interface Design Document to define how each subsystem will interface with the LRC, the LRV, other subsystems, other contractors and other new or existing Administration systems as necessary to form complete, operational, and reliable system.

2. The Interface Design Document shall include, at a minimum:

a. Interface identification and description.

b. Relevant specification requirements.

c. List of other contracts affected by interfaces.

d. Detailed functional description of each interface.

e. Detailed technical requirements.

Detailed physical requirements, such as special hardware and mounting details. Modifications to any of the existing structures to accommodate the contract requirements shall be submitted to the Administration for approval.

2.02 INTERFACES TO EXISTING SIGNAL SYSTEM/OPERATIONAL SIGNAL STAGING PLAN:

A. Prior to commencing the work on integrating the new signaling system with the existing system, Contractor must prepare for approval a Staging and Installation Plan (SIP). This plan in all cases must demonstrate that proper planning, design, installation and testing of all components has been accomplished by the Contractor before interfacing to the existing system. The complete SIP shall be submitted 45 days prior to commencing any cut-over activity as shall include the following items;

1. Signal Systems Safety Requirements Checklists:

   Contractor shall submit appropriate signed off checklists indicating that all system level demonstration testing has been accomplished for the new signal system to be placed in service. These checklists will be used by the Administration as part of the final Certificate of Compliance documentation required for yard operations.

2. Signal System Interface:

   a. Circuit Design.
      Interface circuit designs shall be submitted and properly indicated by ~~XXXX~~ for portions of circuits to be removed and ~~OOOO~~ for portions of circuits to be wired in. “Red” in and “Yellow” out may also be used in conjuction with “~~X~~” and “~~O~~”. The design shall also indicate all proposed circuit revisions needed at each existing interface signal location. Existing circuit plans will be provided by the Administration. Marked circuit plans shall be submitted by Contractor for approval 45 days prior to the beginning of any cutover activity.

3. Signal System Staging Plan:

   A Signal Staging Plan shall be developed by Contractor as a portion of the SIP and submitted to the Administration for approval. The Signal System Staging Plan shall indicate how the Non-Vital Route Request and Indication System is to be placed into service.

The plan shall include, but not limited to, the following items:

a. Track schematics that depict each stage of the cut over. These schematics shall be fully coordinated with all civil and trackwork construction activities.

b. Test procedures and test report sheets to be used during the cut over.

c. Appropriate signal circuit plans required for cutover.

d. Type of interfaces required such as with the Administration and/or others.

e. A detailed schedule of how the tests will be sequenced and implemented, including anticipated man-hours, dates and time periods the tests will be conducted.

f. Specific details on the sequencing of events that will occur during removal of existing and installation of new signaling circuits and equipment.

g. Detailed descriptions as to how Contractor plans to maintain normal operations during the interim stages.

h. Include Contractor's employees and telephone number of those whom will be available for immediate response in case of an emergency.

i. Contractor shall submit, as part of this Plan, an appropriate signed off check sheet to be used to indicate that all system level testing has been accomplished, and that the System(s) can be certified for revenue service operations.

j. Contractor shall identify and submit all requests for approval to the Administration for Work Blocks, Track Outages, Red Tags, and Manpower and Equipment Support. These requests shall be submitted to Administration Operations a minimum of 21 days before any activity.

k. Testing and OM manuals.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Interfaces shall be installed to comply with the referenced standards listed in the Related Sections.

B. Field installation shall conform to the Interface Design Document.

C. Any field modifications shall be reflected in the interface documentation and be resubmitted.

D. Contractor shall closely manage and coordinate its installation schedule to minimize delays to other contractors. Any deviations shall promptly be brought to the attention of the Administration.

3.02 RESPONSIBILITY:

A. With the Administration and other contractors, Contractor shall be responsible for managing the design, coordination, implementation, and testing of its interfaces with all system elements, and between new systems and existing systems.

1. Contractor's interfaces shall function seamlessly.

2. Contractor's interfaces shall be completely documented.

B. Contractor shall have responsibility to investigate and resolve any interface problems relating to its equipment. Interface problems shall be corrected by Contractor at no additional cost to Administration.

C. Contractor shall be responsible for ensuring that each safety related interface is implemented.

D. Interface shall not inhibit or impact existing operations.

PART 4: MEASUREMENT AND PAYMENT

4.01 INTERFACE REQUIREMENTS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17123

WAYSIDE PUSHBUTTONS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for furnishing and installing wayside pushbutton layouts.

1.02 QUALITY ASSURANCE:

A. Factory test all wayside pushbuttons in accordance with manufacturer's standard tests and the provisions of Section 17251.

B. Contractor shall inspect each wayside pushbutton layout after it has been installed in the field. This inspection shall conform to the provisions of Section 17251 and Contractor's Installation Inspection procedure as approved by the Administration. Installation will not be considered complete until the Contractor has corrected all installation defects to the satisfaction of the Administration.

C. Perform field tests as specified in Section 17251.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit manufacturer's product literature and specifications of wayside pushbutton components for approval (CDRL).

B. Prior to purchase or fabrication of wayside pushbutton box assemblies, Contractor shall submit scaled drawings of each type of assembly to be furnished. These drawings shall include, but not be limited to:

1. Enclosure details, including corrosion protection and painting.
2. Installation drawings.
3. Complete key-numbered parts list including ordering information for all components for each type of wayside pushbutton.

C. Submit factory test/inspection procedures for wayside pushbutton layouts. (CDRL).

D. Submit factory test reports for wayside pushbutton layouts (CDRL).

E. Submit field test/inspection procedures for wayside pushbutton layouts (CDRL).

F. Submit field test/inspection reports for wayside pushbutton layouts (CDRL).

PART 2: PRODUCTS

2.01 WAYSIDE PUSHBUTTON LAYOUTS:

A. Each pushbutton layout shall include a pushbutton box, brackets, post, foundation, electrical fittings including junction boxes, terminals, conduit, cable, flexible hosing and all associated hardware to permit electrical connection of the pushbutton box to the CIH.

B. Pushbutton Boxes: Shall be NEMA type 4, Oil-tight, weatherproof, metal enclosures with oil-tight buttons, indicator LEDs, and legend plates as shown in the Bid Documents.

1. Pushbuttons shall be equipped with red mushroom-shaped actuators. Pushbutton contacts shall be capable of breaking a load consisting of three non-vital relays connected in parallel, 1 million times without contact resistance exceeding 1.0 ohms. Pushbuttons shall have a mechanical life of at least 5 million operations and free from sticking or freezing up.

2. Indicator lights shall be complete with socket, lamp, and white plastic cap. Lamps shall be clear, 12V, LED type.

3. Key switches shall be Oil-tight and weatherproof and have a mechanical life of at least 5 million operations and free from sticking or freezing up.

4. Key switches shall hold the key captive when moved from their locked position and release the key when returned to their locked position.

5. Legend plate shall be black with white lettering.

6. Indicator lights, pushbuttons, key switches and legend plates shall be mounted on a removable front panel.

7. Legend plates above the route selection pushbutton and its associated indicator shall carry the nomenclature of the destination track the vehicle/train will be routed to, for example TR 13 (Track 13:). Should

there be more than one potential route to the destination track, a pushbutton shall be installed for each route with a brief description of the route for example TR 13 (Track 13 via track x or via switch x reverse or normal) The cancel pushbutton shall have a legend plate above the pushbutton with the nomenclature CANCEL for canceling an established route. The plate shall also have an arrow indicating direction of travel.

8. An individual hood shall shield each pushbutton and indicator LED. The hood shall be designed to protect the pushbutton assembly from the accumulation of ice and snow on the pushbutton shaft or actuator. A minimum 0.25 inch clearance shall be maintained between the hood and pushbutton and between the hood and indicator light. Hoods shall not impair the operation, maintenance and visibility of wayside pushbutton equipment.

9. Each Pushbutton box shall be equipped with a terminal strip with the capacity to terminate all cable wires entering the pushbutton box with 10% additional spare terminals.

PART 3: EXECUTION

3.01 GENERAL:

A. Wayside pushbutton layouts shall be designed and installed to provide LRV operators with the ability to initiate a route by using wayside pushbuttons.

B. Provide a pushbutton and an indicator light for each route possible from every wayside pushbutton location.

C. Contractor shall install or modify pushbutton boxes at locations as shown on the Bid Documents.

3.02 WAYSIDE PUSHBUTTON LAYOUT:

A. Install pushbutton boxes on 4 inch pipe post mounted on a pedestal. Mount pedestal on precast concrete foundations with anchor bolts as specified in Section 17211.

B. Install pushbuttons in accordance with the dimensions set forth in the contract drawings.

C. Layout of pushbutton panels shall be in accordance with the contract drawings.

D. Where two pushbutton boxes are required back-to-back for adjacent tracks, both pushbuttons shall be mounted to a common post assembly. Two example post and mounting configurations are shown in the contract drawings but the Contractor may propose another alternative if it provides the same structural integrity and functionality and utilizes the swivel brackets as shown.

E. The Contractor shall participate in a joint inspection with the Administration to finalize the location of all pushbutton layouts.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. New pushbuttons assemblies will be measured on a unit price basis installed in place complete with all hardware and accessories described herein, foundation, grounding and cable.

B. Replacement components for existing pushbuttons will be measured as a lump sum item

4.02 PAYMENT:

A. New pushbutton assemblies will be paid at the contract unit price for each new pushbutton assembly installed in place.

B. Replacement components for existing pushbuttons will be paid for at the contract lump sum basis installed in place.

END OF SECTION

SECTION 17139

CABLE TROUGH

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work of this Section consists of furnishing and installing the cable trough under this contract.

B. Related Work Specified Elsewhere:

1. Wayside Pushbuttons: Section 17123
2. Pushbutton Foundations: Section 17211
3. Wheel Detectors: Section 17142
4. Conduits: Section 17173

1.02 DEFINITIONS:

A. HDPC – High Density Polymer Concrete

1.03 OVERALL REQUIREMENTS:

A. Cable Trough shall be polymer concrete type.

B. Provide trough for installation as shown in the Bid Documents.

C. Trough sizes to be provided and installed per contract drawings.

D. Interface trough to existing trough and new conduits.

E. Provide and install conduit between trough and specified Route Selection Pushbutton Assemblies and Wheel Detectors as shown in Bid Documents.

1.04 SUBMITTALS:

A. Submit the following according to Conditions of the Contract and Division 01300 Submittals:

1. Product data for trough and miscellaneous components (CDRL).

2. Coordination drawings showing trough layout profiles coordinated with all system facilities, utilities, and all other existing and proposed installations.

1.05 QUALITY ASSURANCE:

A. Manufacturer Qualifications: Experienced in providing underground utility structures of types and sizes required and similar to those indicated for this Project. The Manufacturer shall provide a list of references where these types of structures have been previously supplied.

B. Comply with NFPA70 "National Electrical Code" and ANSI C2 "National Electrical Safety Code" for components and installation.

1.06 DELIVERY, STORAGE, AND HANDLING:

A. Ship and store troughs with supports to prevent bending, warping, breakage, and deforming. Deliver troughs to site with ends capped.

PART 2: PRODUCTS

2.01 CABLE TROUGH:

A. Cable troughs and associated transitions shall be Plastibeton or approved equivalent.

B. Cable trough and associated transitions system shall consist of polymer concrete type. The trough material shall be resistant to ultra violet deterioration, impervious to chemicals and shall not absorb water.

C. Cable trough shall be sized and provided as shown on contract drawings. Trough dimensions are to support future work in North Avenue Yard. The sizes and transitions points are therefore required as shown however the detailed design shall be the Contractor’s responsibility.

D. Product Specification:

1. The trough shall be provided in flame retardant compounds meeting Underwriter Laboratory UL-94 V2, V1, or V0 manufactured from high density polyethylene.

2. Provide manufacturer’s plug caps for handling holes, leveling blocks and lid support brackets at “Tee” junctions.

PART 3: EXECUTION

3.01 EXAMINATION:

A. Examine site to receive troughs for compliance with installation tolerances and other conditions affecting performance of the underground troughs.

3.02 EARTHWORK:

A. Excavation and Backfill: Adhere to the Administrations and manufacturer's installation and handling procedures.

B. Disturbed Paving: Restore disturbed paving to original condition.

3.03 CABLE TROUGH INSTALLATION:

A. Applications:

1. Cable trough shall be installed per manufacturer's installation instructions.

2. Cable trough shall be the primary cable duct from the CIH Manholes to each pushbutton and wheel detector location.

3. Cable trough shall be installed in track ballast and situated between and across tracks as shown on contract drawings.

4. Each trough sections shall be supported by manufacturer's leveling blocks at each end.

5. All trough intersections and transitions are to be cut in the field. Ninety degree intersections and transition shall only be permitted at trough connections to switch machines. All other transitions and intersections shall be at angles other than ninety degrees.

6. Use of "river rock", "washed stone/aggregate", or "pea gravel" as a backfill material will result in unacceptable performance and will not be accepted. The use of such rounded material is prohibited.

7. After trough is in place, plug all handling holes with manufacturer's plugs.

B. Cable trough shall be installed in the following configurations per manufacturer's installation instructions:

1. Cable Trough Transitions:

a. The cable trough shall be designed to accommodate a composite 3° bend between 2 joined sections which is sufficient to permit cable trough to parallel track curve without modification.

b. A handhole or a trough sweep shall be used when forming a 90° or “tee” intersection with cable trough.

c. A handhole shall be used for terminating straight runs of cable trough.

d. Larger vaults or manholes shall be used for accommodating slack loop storage for fiber optic cable or splice closures.

e. Transition products installation practices shall be the same as for the cable trough.

f. Install manufacturer’s lid support brackets around “Tee” junctions.

2. Trench Restoration:

a. Backfill shall begin once the lids are installed on the total span length between vaults or manholes/handholes.

b. Returned or add ballast in layers of approximately 4 inches, compacting between layers. Work on both sides of cable troughs shall occur simultaneously. Ballast shall be clean, free of frozen material or organic matter.

c. Backfill material shall be compacted as described above.

d. During construction or periods when heavy vehicular traffic is anticipated, 1 inch thick steel plates shall be positioned over channels and lids extending 2 feet on to surrounding ballast.

e. It is acceptable to expose up to approximately 5 inches of cable trough sidewall above ballast grade. However, provision must be made to protect cable trough sidewalls from vehicular traffic. (See Bid Documents on details for specific layout and installation dimensions).

3. Between Track Installation:

a. Cable trough shall be buried in ballast up to the height of one inch above ballast. The cable trough shall be installed between parallel tracks in existing ballast. In all locations, material shall be removed as required providing sufficient depth for base preparation.

4. Cross Track Installations:

a. Cable trough installed between ties shall be one inch below bottom of rail. Trough level shall be adjusted to match to service road crossing elevations.

b. Cable trough shall be cut as required so trough installed in service aisle crossings shall match existing service aisle elevations.

c. Ties shall be adjusted as required to accommodate trough installations.

C. Cable Installation:

a. The cable trough inside surface shall be smooth and free of any protrusions reducing the potential for cable damage during installation. The bottom of the trough shall have holes to prevent water/frost build-up.

b. The cable trough shall be drilled in the bottom for transition to conduits for cable installation. All cable between trough and equipment shall be installed in conduit.

3.04 FIELD QUALITY CONTROL:

A. Demonstrate capability and compliance with requirements upon completion of installation of trough and utility structures.

B. Correct installations where possible, and retest to demonstrate compliance. Otherwise, remove and replace defective products and retest.

3.05 CLEANING:

A. Clean internal surfaces of trough.

B. Remove foreign material.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Cable trough will be measured by the linear foot, installed in place complete with covers and all associated parts and materials including handholes.

4.02 PAYMENT:

A. Cable trough will be paid at the contract unit price per foot for each foot of cable trough installed in place.

END OF SECTION

SECTION 17142

WHEEL DETECTORS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to design furnish and install wheel detectors and their ancillary equipment in the MTA CLRL North Avenue Yard.

1.02 QUALITY ASSURANCE:

A. Factory test all wheel detectors in accordance with approved procedures as specified in Section 17251.

B. Field test all mainline track circuits in accordance with approved procedures as specified in Section 17251.

1.02 SUBMITTALS: Unless otherwise specified all submittals shall be in accordance with Sections 01300.

A. Submit manufacturer's product literature, shop drawings and specifications of Wheel detectors for approval (CDRL).

B. Submit installation drawings for Wheel detectors (CDRL).

C. Submit as-built installation drawings for Wheel detectors (CDRL).

D. Submit installation, maintenance and operation manuals for Wheel detectors (CDRL).

E. Submit factory test procedures for Wheel detectors (CDRL).

F. Submit factory test reports for Wheel detectors (CDRL).

G. Submit field test/inspection procedures for Wheel detectors (CDRL).

H. Submit field test/inspection reports of for Wheel detectors (CDRL).

PART 2: PRODUCTS

2.01 GENERAL WHEEL DETECTOR REQUIREMENTS:

A. Wheel detectors shall perform the function of LRV/train detection.

B. Rail mounted wheel detectors shall be the two element sensor type capable of sending impulses via an amplifier to the wheel detector controller.

C. The wheel detector controller will have the capability of determining train direction and/or speed based on analysis of these impulses. The wheel detector controller will indicate track occupancy by energizing or de-energizing a relay.

D. A combination of wheel detectors will define a wheel detector zone. Wheel detector zones for the North Avenue Yard are as shown in the contract drawings.

E. There shall be 3 wheel detector zones for the south yard interlocking, one wheel detector zone for the north yard interlocking. In addition there shall be optional zones for the north interlocking tail track and each of storage tracks 6 to 13 as shown in the contract drawings and described in section 01110.

F. The wheel detector controller will have the capability of determining occupancy of a zone regardless of train direction.

G. Wheel detectors shall be compatible with the traction power negative return.

H. Restoration of power after a power failure shall not automatically restore wheel detectors to normal operation. The wheel detectors shall indicate track occupation until reset manually.

1. Restoration of the wheel detectors shall be accomplished at the wheel detector controller and shall have the ability to reset the controller to the actual number of axles occupying a particular track and /or zone.

I. Wheel detectors shall function properly in an uncontrolled temperature environment from –40 degrees F to 160 F.

L. EMI Requirements:

1. Wheel detectors shall be immune to EMI generated by the vehicle, the traction electrification system, the communications system, area power lines, the rail system environment, and any other electromagnetic noise.

2. Any form of EMI between adjacent wheel detectors on the same track or wheel detectors on adjacent tracks shall not affect safe operation or reliability of either wheel detector system.

2.02 WHEEL DETECTOR SUPPORTING EQUIPMENT:

A. In addition to the rail mounted detectors, the contractor shall provide all cabling, wiring, amplifiers, relays, wheel detector controllers, output relays and hardware necessary to provide a complete system.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Install wheel detectors in accordance with manufacturer's instructions and at locations and in accordance with the Bid Documents.

B. Cabling for wheel detectors shall be with two twisted pair shielded cable from the wayside installation to the CIH and specified in Section 17221. Wheel detector cabling on the wayside shall be properly tagged and labeled.

C. The contractor shall participate in a joint inspection with the Administration to finalize the location of each wheel detector.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Rail mounted wheel detectors will be measured on a unit price basis installed in place complete with all hardware and accessories described herein, and cable.

B. Wheel detector controllers and output relays will measured on a unit price basis installed in place complete with all associated wiring and connections

4.02 PAYMENT:

A. Wheel detectors will be paid at the contract unit price for each new wheel detector installed in place.

B. Wheel detector controllers and output relays will be paid at the contract unit price for each new controller and output relay installed in place

.

END OF SECTION

SECTION 17161

JUNCTION BOXES

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to furnish and install Junction Boxes.

1.02 QUALITY ASSURANCE: Factory test all Junction Boxes in accordance with approved procedures as specified in Section 17251.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Sections 01300.

A. Manufacturer's product literature, shop drawings and specifications of Junction Boxes for approval (CDRL).

B. Submit installation drawings for Junction Boxes (CDRL).

C. Submit as-built drawings for all Junction Boxes (CDRL).

1.04 WIRING AND SHIPPING:

A. Install internal wire and cable in accordance with the applicable requirements of AREMA signal Manual Part 10, Instruction for Wiring as specified herein and as shown in the Bid Documents.

B. All wires terminated on AREMA type binding posts or barrier strips shall be fitted with an approved insulated crimp terminal in accordance with AREMA Signal Manual, Part 14.

C. Each junction box shall be shipped complete with identification tags, terminals, and associated apparatus.

D. Hardware for each junction box shall be shipped complete with junction box.

E. All components, products, and hardware shall be protected from damage throughout delivery, storage, and handling.

F. Any such component, product, or hardware damaged during delivery, storage, and handling shall be replaced by Contractor with no additional cost to Administration.

I. All wires leaving the junction box shall be terminated at the terminal board on a test terminal, which shall permit the circuit to be opened by releasing a terminal nut. This operation shall not loosen any of the circuit wires nor release any loose links.

J. All vital wiring shall meet minimum requirements specified in Section 17221 and in accordance with AREMA Signal Manual Part 10, Instructions for Wiring.

K. All wiring shall be provided with sufficient slack to prevent stress or pulling on any termination point.

L. All grounding shall be in accordance with Section 17215.

PART 2: PRODUCTS

2.01 GENERAL:

A. Identification for junction boxes shall be stenciled white or black paint, in contrast to junction box finish.

B. Finishes: Where applicable and unless specified otherwise elsewhere, the following requirements shall apply to all junction boxes.

1. Exterior metal surfaces, if galvanized steel shall be painted with 1 coat of rust inhibitive vinyl primer and at least 2 finished coats of high solids vinyl.

2. The finished color for junction boxes shall be white, black or silver in color.

3. Interior metal surfaces. Of galvanized steel, apply one coat of rust inhibitive vinyl primer and at least one finish coat of high solids vinyl. Minimum dry film thickness shall be 2 mils. Color shall be the manufacturer's standard for the service specified.

2.03 WAYSIDE JUNCTION BOXES:

A. All junction boxes shall conform to NEMA-4X and UL requirements. Junction boxes shall be constructed of 14 gauge stainless steel, aluminum or powder-coated galvanized steel and vented as approved by the Administration.

B. Terminals: Each junction box shall be equipped with sufficient AREMA type terminals to terminate all wires entering the box. AREMA terminals shall be equipped with slotted sliding disconnect straps to facilitate testing. 25% spare terminals shall also be provided.

C. Interior painted in accordance with 201.B.

D. If the junction box interior is aluminum or stainless steel, it shall not be painted.

E. Locking device on cover shall prevent locking unless door is completely closed.

F. Boxes shall be dust-proof and weatherproof with a drip shield above the door. Doors sheet metal boxes shall be hinged with non-corrosive hardware and equipped with a latching arrangement complete with a handle and hasp for a standard Administration padlock.

G. Padlocks shall be as specified in Section 17263.

H. Size as needed, with all terminals accessible from the front, and shall accommodate the minimum-bending radius of wires and cables.

I. Container inside for storage of wiring diagram.

J. Drains: Sheet metal junction boxes shall be equipped with drains covered with a screen. Screen shall be the same material as the junction box.

PART 3: EXECUTION

3.02 WAYSIDE JUNCTION BOXES:

A. Mount in such a manner that no part, including doors in the open position, will project into the LRV clearance envelope.

B. Terminate all wire and cable on internal terminal blocks.

C. Stencil the exterior of the door to identify location.

D. Place copy of wiring diagram in container provided.

E. Junction boxes shall be mounted at an approved convenient working height. Underground cable entrance shall be through the foundation and pedestal pipe into the bottom of the junction box.

F. Each junction box shall have an individual wiring diagram. Each terminal shall be identified by a terminal number tag that is also shown on the wiring diagram.

G. Each wire terminated in the junction box shall be identified with a permanent sleeve carrying the circuit nomenclature.

PART 4: MEASUREMENT AND PAYMENT

4.01 WAYSIDE JUNCTION BOXES:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17171

RELAYS AND PLUGBOARDS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to furnish and install signal relays and plugboards.

1.02 QUALITY ASSURANCE:

A. Relays shall be tested at the point of manufacture as specified in Section 17251.

B. Relays of each type shall be uniform in design and contact assembly.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit relay specifications and drawings showing contact stacking arrangements, and mounting and supporting arrangements for all relay types supplied for this Contract (CDRL).

B. Submit mean time between failure data for all relays (CDRL).

C. Submit 15 copies of the following:

1. Relay manuals as specified in Section 01301, with comprehensive descriptions and illustrations of any type of relay not currently in use in the yard CIHs (CDRL). Include such items as relay operation, testing, adjustments, wiring diagrams, a complete illustrated parts list and other pertinent information for maintenance and testing.

2. Instruction manuals, as specified in Section 01301, with a description of contact insertion and removal and recommended methods of plugboard mounting, assembly, and maintenance (CDRL).

D. Submit product literature for all vital relays and plugboards (CDRL).

E. Submit field test procedures for all vital relays and plugboards (CDRL).

F. Submit field test reports for all vital relays and plugboards (CDRL).

PART 2: PRODUCTS

2.01 RELAYS:

A. General: All signal/train control logic shall be generated by microprocessor-based systems. Use of relays shall be minimized as much as possible. Where Relays are required for specific applications, they shall meet the following requirements:

1. All relays shall be quick detachable plug-in type.

2. Relays shall be identified with manufacturer's name, model number, contact identification, and serial number.

3. Interchangeable with relays of the same type used elsewhere.

4. Plug-in type relays shall be equipped with a handgrip or other method for easy removal or insertion into plugboards.

5. Plug-in type relays shall be equipped with a latching mechanism or other type of fastening arrangement to provide firm attachment in the plugboard.

6. All relays equipped with a minimum of 1 spare front-back dependent contact for each relay function.

7. The status of energized or de-energized for all relays shall be easily viewed from the front.

B. Non-Vital DC Relays: Non-vital signal logic shall be accomplished with non-vital logic controllers or the non-vital portion of a microprocessor-based interlocking control system. Non-vital relays where required, shall meet the following requirements:

1. General:

a. Non-vital logic relays shall be mounted in racks and furnished with transparent dust-proof covers that will not support combustion.

b. As an option, relays may be mounted in dust-proof cabinets that shall have transparent front plates that do not support combustion. These cabinets shall be mounted in racks as specified.

c. Individual relay covers or the cabinet in which several

relays are mounted shall permit viewing the relay without disassembly to determine whether the relay is energized or de-energized.

d. Relays shall have an indication lamp located below or on the relay to indicate if the relay is energized or de-energized. Indication lamp can be external and mounted next to and below the relay. External indication lamp shall be driven by the relay's front contact and its energy bus tied to the maintenance test panel lamp switch activation. If the indication lamp fails, the relay shall continue to operate.

e. Non-vital relays shall have 1 spare front-back dependent contact.

2. Logic Relays:

a. Operating voltage: as for vital relays.

b. Response of less than 100 milliseconds when energized with 75 percent nominal voltage.

c. Response of less than 50 milliseconds when de-energized from nominal voltage.

d. Arc suppression built into the relay or attached to the plugboard.

e. A minimum of 4 front-back dependent contacts capable of carrying 1A continuously without contact resistance exceeding 5 ohms.

f. Front or back contacts capable of breaking a load consisting of 3 vital or non-vital relays connected in parallel at least 10 million times without contact resistance exceeding 5 ohms measured at 10 milliamps.

g. Constructed to assure that contacts break before make.

h. AREMA Signal Manual, Part 6.3.5 except as otherwise approved by the Administration.

3. Non-Vital Indication Relays:

a. Minimum of 2 front contacts.

b. Each contact shall be metal-to-metal, capable of carrying and breaking a load with the following characteristics:

1. Maximum volt-amp load: 15 VA.
2. Maximum continuous load current: 1A.
3. Maximum switched voltage: 250VDC.

c. Each contact shall be capable of breaking a resistive load with the above characteristics, or an inductive load suppressed so at no time during steady state or switching conditions does the load exceed the above characteristics, at least 1.5 million times without the contact resistance measured in a 3VDC circuit exceeding 3 ohms.

d. Capable of the electrical operation specified above after 10 million mechanical cycles without an electrical load on the contact. Under all conditions, minimum open contact resistance shall be 50 megohms at 400VDC. Maximum duration of contact bounce shall be 5 milliseconds.

e. Arc suppression on the coils shall prevent the load presented to a contact controlling each relay coil from exceeding the following values during steady state or switching conditions:

1. Maximum volt-amp load: 15 VA
2. Maximum load current: 1 A.
3. Maximum switched voltage: 250VDC

f. Printed circuit board mounted relays are not acceptable.

4. Non-Vital Heavy Duty Relays: Meeting the same requirements as non-vital logic relays except as follows:

a. Equipped with a minimum of 2 front-back contacts capable of carrying and breaking a resistive or inductive load, which does not exceed the following characteristics, 1 million times without the contact resistance, measured at 5A, not exceeding 1 ohm.

1. Maximum continuous volt-amp load: 200 VA
2. Maximum volt-amp load while relay contact is opening (transient due to inductive surge): 350 VA.
3. Maximum instantaneous load current: 5A.
4. Maximum continuous load current: 5A.
5. Maximum instantaneous switched voltage:

100VDC.

b. Each contact shall be capable of carrying and breaking a resistive or inductive load, which does not exceed the following characteristics, 5,000,000 times without the contact resistance, when measured at 0.5A, not exceeding 1 ohm:

1. Maximum continuous volt-amp load: 50 VA
2. Maximum volt-amp load while relay contact is opening (transient due to inductive surge): 90 VA.
3. Maximum instantaneous load current: 1.25A.
4. Maximum continuous load current: 1.25A.
5. Maximum instantaneous switched voltage: 100VDC.

2.02 RELAY PLUGBOARDS:

A. A plastic type plugboard for each plug-in relay.

B. Each plugboard shall have a tag, or other approved means of identification (front and rear), to indicate the nomenclature of the relay for which it is wired.

PART 3: EXECUTION

3.01 RELAYS:

A. Ensure relay operating characteristics have not been altered due to damage during shipping or storage. Relays shall be shipped separately and not installed on racks when shipped.

B. In the field, install relays on relays racks in each CIH and or on standard spaced relay support bars in each equipment case. Backboards are not permitted.

C. No relay shall be mounted on the first row above the finished floor. However, this space may be used in determining spare space requirements for the relay rack.

D. Attach no more than 2 wires to a relay connector.

3.02 PLUGBOARDS:

A. Provide relay plugboards that are factory mounted and wired.

B. Use non-corrosive fasteners to mount plugboards on relay rack.

C. All wires terminating at a relay shall have sufficient length to connect to any terminal on the relay.

D. The wire on each contact shall carry an approved tag as specified in Section 17263.

PART 4: MEASUREMENT AND PAYMENT

4.01 RELAYS AND PLUGBOARDS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

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END OF SECTION

SECTION 17173

POWER SUPPLIES, TRANSFORMERS & OTHER ELECTRICAL COMPONENTS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications for electrical and electronic components.

1.02 RELATED WORK IN OTHER SECTIONS:

17161 Junction Boxes.
17251 Tests and Inspections.
01300 SP – Submittal Procedures.

1.03 QUALITY ASSURANCE:

A. Factory test all electrical and electronic components prior to installation in accordance with manufacturer's test procedures and the provisions of Section 17251.

1.04 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit manufacturer's specifications, product literature, and Shop Drawings (CDRL) for:

1. Power supplies.

2. Transformers.

3. Printed circuit cards.

4. Printed circuit card connectors.

5. Lightning Arresters.

6. Surge Protection.

B. Submit installation drawings for all electrical and electronic components (CDRL).

C. Submit installation, maintenance and operation manuals for all electrical and electronic components (CDRL).

D. Submit factory test procedures for all electrical and electronic components (CDRL).

E. Submit factory test reports for all electrical and electronic components (CDRL).

F. Submit field test procedures for all electrical and electronic components (CDRL).

G. Submit field test reports for all electrical and electronic components (CDRL).

PART 2: PRODUCTS

2.01 GENERAL:

A. Electrical and electronic components shall be:

1. New, and free of manufacturing defects.

2. Free of storage and handling damage.

3. Clearly and permanently labeled with values or type identification.

4. Rated to operate at levels exceeding by at least 25 percent over those parameters such as power, voltage, current, and temperature at which the component will be subject to in service, except as otherwise specified.

5. Capable of operating in the environment specified.

2.02 DC POWER SUPPLIES:

A. General: All DC power supplies shall meet the following requirements:

1. Power supplies shall be designed for a continuous duty cycle.

2. Internal Transformers: Transformers used in DC power supplies shall not emit an audible noise in excess of 50dB at a distance of 3 feet.

3. Electrical Insulation: Power supplies shall be insulated to withstand, for 1 minute, 600VAC, 60Hz, applied between the input and output leads when connected together.

4. Cooling: Power supplies shall be designed to use natural

convection cooling. Fans or other cooling devices are unacceptable.

5. Failure Alarm:

   a. DC power supplies shall be equipped with a failure alarm device to detect any internal failure that would prevent the power supply from delivering its full rated load. Such device shall be normally energized by a small percentage of the load current and cause two separate internal contact to open when a failure is detected.

   b. One set of contacts shall control an external alarm indication circuit. The other set shall illuminate a lamp or LED indicator mounted on the power supply. Such indication shall function even if the output voltage is maintained by a tandem power supply.

   c. Indication lamp or LED shall be so designed as to be replaceable without removing the power supply or adjacent equipment from the rack.

6. Input Voltage: Power supply shall not be damaged by a sustained input varying from 0 to 150 percent of the rated input voltage.

7. Current rating: Power supplies shall be so designed that no individual power supply operates at less than 20 percent of its rated current output during normal operation.

8. Output Current: Power supplies shall self-limit their output current to no more than 200 percent of their rated load unless otherwise specified.

9. Identification: Each power supply shall be clearly and permanently labeled with the following:

   a. Manufacturer’s name.

   b. Part or model number.

   c. Serial number.

   d. Input rating.

   e. Output rating (continuous or intermittent).

10. Components and wiring:

    a. Components shall be as specified in this Section.

    b. Power supplies designed to be repaired in the rack, shall have all components in modular assemblies that do not require soldering to replace.

11. Power supply shall be mounted on a panel chassis with a perforated protected cover, to allow natural convection cooling.

12. Contractor's design shall allow for a power supply to be mounted on a rack with other power supplies and ensure the convection area and other components are sized for proper heat dissipation.

13. Power supply front panel shall contain an output ammeter, and an output voltmeter (this may be one meter with selector switch). Meter accuracy shall be ±2 percent.

14. Power supply outputs shall be filtered and regulated such that the supply voltage remains stable.

    a. Voltage regulation shall be sufficient to ensure continuous operation of all connected equipment. Voltage regulation shall not exceed 5 percent of the nominal output voltage, with line voltage between 105 and 125VDC.

    b. Ripple shall not exceed 1 percent at full rated load.

2.03 ELECTRICAL DEVICES FOR OTHER APPLICATIONS:

A. Fuses:

1. Non-renewable, of the fiber-case, time-lag, fusion type.

2. Correct size and rating to protect the electrical equipment from overload.

3. In DC branch circuits, where fusing is impractical, a protective resistance unit shall be provided.

4. All fuses shall be centrally located on the power distribution panels or racks.

B. Circuit Interrupters (Breakers): Equipment intended to break current at fault levels shall have interrupting rating sufficient for the system voltage and the current which is available at the line terminals of the equipment. Equipment intended to break current at other than fault levels shall have an interrupting rating at system voltage sufficient for the current that must be interrupted.

1. Circuit interrupters may be required in lieu of fuses at the discretion of the Administration.

2.04 LIGHTNING ARRESTERS:

A. General: The CLRL system lies within an area which experiences 100 or more thunderstorm days a year, one of the most severe levels for the nation.

B. Lightning arresters shall be provided to protect signaling equipment.

C. Arrester Types:

1. Signal arresters shall be specifically designed for railway signaling use.

2. Contractor shall provide proper arresters designed for protection of vital safety circuits that cannot be grounded without reducing safety.

3. The primary functions of the signal arrester shall be to provide line to line and line to ground protection. This requirement shall not exclude the arrester from performing other functions.

4. Arresters, line to ground type:

a. Arresters shall pass negligible current at rated circuit voltage.

b. Arrester failure mode shall be to open rather than a short circuit or partial short circuit.

c. Arresters shall be heavy duty and suitable for circuits of 0 to 35VDC without impedance restrictions.

d. Arresters shall have an average DC breakdown voltage of 1000V or less.

e. Arresters shall have a maximum impulse spark-over voltage not exceeding 2,000V peak for an impulse with a 10 kV/microsecond rise time.

5. Arresters, line to line type:

   a. Arresters shall pass negligible current at rated circuit voltage.

   b. Arresters shall be suitable for circuits of 0 to 20V without circuit impedance restrictions.

   c. Arresters may be used on circuits having voltages higher than 20V when the circuit has sufficient impedance to limit the follow-through current after a surge to a value that can be interrupted by the arrester.

   d. Arresters shall have an average breakdown voltage of 200V or lower.

   e. Arresters shall have a maximum impulse spark-over voltage not exceeding 500V peak for an impulse with a 10 kV/microsecond rise time.

2.05 SURGE PROTECTION:

A. Surge Protection: Surge Protection shall be a shunting device, which triggers at a specified voltage to protect solid state equipment and other types of signaling and track circuit equipment from surges of AC or DC power. It must also provide an external indication for maintenance purpose.

B. Application: Surge protection shall be provided on all equipment for protection against AC or DC power line surges.

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 POWER SUPPLIES, & OTHER ELECTRICAL COMPONENTS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17175

CONTROL PANELS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to furnish and install Maintenance Touch Screen Panels (MTSP) in CIHs.

1.02 QUALITY ASSURANCE:

A. Factory test all MTSPs in accordance with approved procedures as specified in Section 17251.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit manufacturer's product literature and specifications of MTSPs for approval (CDRL).

B. Submit shop drawings for MTSPs (CDRL).

C. Submit installation drawings for MTSPs (CDRL).

D. Submit as-built drawings for MTSPs (CDRL).

E. Submit installation, maintenance and operation manuals for MTSPs (CDRL).

F. Submit factory test procedures for MTSPs (CDRL).

G. Submit factory test reports for MTSPs (CDRL).

H. Submit field test procedures for MTSPs (CDRL).

I. Submit field test reports for MTSPs (CDRL).

PART 2: PRODUCTS

2.01 MAINTENANCE TEST PANEL:

A. Provide a separate MTSP for South and North CIHs respectively.

B. MTSP shall consist of an LCD plasma touch screen. The track diagram, signal and switch symbols, lettering, and identification numbering shall be configured on the panel display as described in specification section 01110.

C. MTSP shall possess a viewable screen of not less than 32 inches diagonal. Actual size shall accommodate all required graphics for the control and indication display in a manner that allows all fonts to be read and provides adequate separation between touch selection points to avoid the probability of selecting a wrong touch point because of close proximity to the desired point.

D. MTSP shall provide applicable controls and indications necessary for:

1. Track occupancy - indication.

2. Switch position - control and indication.

   a. Switch position control shall use a drop down menu for requests and cancel

3. Route request/cancel - control and indication.

   a. Route request control shall use a drop down menu for requests and cancel

4. AUTO/MANUAL/ROUTE PUSHBUTTON/SWITCH PUSHBUTTON mode - control and indications.

5. Local Control TRANSFER Request- control.

6. Light Rail Control – Indication.

7. Screen Test - control and indication.

13. Track Block – control and indication

14. Switch Block – control and indication

15. Route Alignment Indication.

16. Power Off Alarm

E. Panels located in South and North CIHs shall indicate track occupancy of track circuits for the entire yard.

F. AUTO/MANUAL/ROUTE PUSHBUTTON/SWITCH PUSHBUTTON mode controls shall be software generated functions displayed on the MTSP.

G. The panel display shall represent the actual geographic track layout relevant to direction of routes including CIH 94 N layout.

H. All exterior wiring shall be plug-coupled cables.

I. Shall be manufactured by Magelis or approved equal.

PART 3: EXECUTION

3.01 MAINTENANCE TOUCH SCREEN PANEL:

A. Mount the MTSPs on “Wall C” of the south CIH, and “Wall C” of the north CIH close to the entrance door as shown in the contract drawings.

B. Location of the panel shall permit free access for an operator to stand in front. Panel shall be oriented so the operator will face both the panel and track.

C. Operation of the Maintenance Touch Screen Panel shall be as described in specification section 01110.

PART 4: MEASUREMENT AND PAYMENT

4.01 MAINTENANCE TOUCH SCREEN PANEL:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in Bid Item 009.

END OF SECTION

SECTION 17177

EVENT RECORDERS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications for microprocessor-based event recorders to be installed at each CIH location.

1.02 RELATED WORK IN OTHER SECTIONS:

17251 Signals – Testing & Inspections.
01300 SP – Submittal Procedures.

1.03 QUALITY ASSURANCE:

A. Factory test all event recorders prior to installation in accordance with manufacturer's test procedures and the provisions of Section 17251.

1.04 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Sections 01300.

A. Submit manufacturer's specifications, product literature, and shop drawings for event recorders (CDRL). Include hardware and software specifications, functional descriptions, block diagrams, and flow charts, for all hardware and software. Software listings shall be provided which accurately and completely characterize the operating and application programs in use and fully describe the means to reprogram the equipment at the user level (CDRL).

B. Submit detailed equipment layout and a bill of materials (CDRL).

C. Submit installation, maintenance and operation manuals (CDRL).

D. Submit factory test procedures for event recorders (CDRL).

E. Submit factory test reports for event recorders (CDRL).

F. Submit field test procedures for event recorders (CDRL).

G. Submit field test reports for event recorders (CDRL).

PART 2: PRODUCTS

2.01 GENERAL:

A. Event recorders shall be microprocessor-based, containing non-volatile solid state memory for data storage. It shall be designed for easy use and maintenance.

B. Event recorders shall be capable of downloading event data to a laptop computer utilizing an RS-232 interface.

C. Multi-channel, multi-speed system, containing self-test capability.

D. Designed for continuous real-time monitoring and recording of a wide range of functions associated with a highway crossing, interlocking or similar installations.

E. Unit memory shall be cyclical, with 168 hour minimum capability. When memory storage capacity is reached, the oldest event will be erased and replaced with the event containing the newest information. Each event shall be dated and time stamped.

F. Event recorder shall record as a minimum and not limited to the following information:

1. Track circuits.
2. Pushbutton request.
3. Pushbutton indication.
4. Switch request.
5. Switch position.
6. Switch locking.
7. Route check.
8. Absolute block.
9. Power off.
10. Route Pushbutton Operation / Maintenance Touch Screen Panel/ Existing yard switch pushbuttons.
11. Door entry.

G. Event recorder shall be complete with modem interface for remote data retrieval.

H. Housed in a dust-proof enclosure.

I. Event recorder may be incorporated into the microprocessor interlocking control system.

J. System configuration information, executive software, application software shall be capable of being loaded and performed in the field or remotely.

K. Backup software (executive, application) shall be provided to the Administration on CD-ROM.

2.02 EVENT RECORDER:

A. Operating temperature: -40°F to +160°F.

B. Operating voltage: 9-32VDC range, 12-24VDC nominal.

C. Inputs:

1. Digital: All required inputs plus 10% spare, at up to 32VDC.

2. Analog: Minimum 4, at up to 32VDC, 120VAC.

D. Built-in real time clock.

E. Minimum number of events: 100,000.

F. I/O Display: LED indicators.

G. Serial Ports: Two isolated RS-232 compatible ports.

H. Surge Protection/Isolation: Primary surge protection on all interfaces including battery. Secondary surge protection provided on all boards. Meets all applicable AREMA requirements for isolation and grounding.

I. Mounting: Capable of being rack, shelf or wall mounted.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Event recorder shall be installed in accordance with approved installation drawings and in accordance with manufacturer's recommendation.

B. Contractor shall field test event recorder in accordance with approved test procedures in as specified in Section 17251.

PART 4: MEASUREMENT AND PAYMENT

4.01 EVENT RECORDERS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the Bid Item 009.

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END OF SECTION

SECTION 17195

MICROPROCESSOR INTERLOCKING SYSTEM

PART 1: GENERAL

1.01 DESCRIPTION:

A. The work to be done under this Section consists of design, furnish, installation and testing of microprocessor interlocking signal logic system as described in this and other sections. This system is to be implemented in a non-revenue application in MTA's North Avenue Yard.

B. All signal logic and safety functions shall be processed and implemented with non-vital microprocessors.

C. A normal and a standby programmable logic controller (PLC) located in South CIH shall be used to perform all signal logic functions. These PLCs shall be fed by I/O modules and linked to adjacent interlocking by fiber optic cable.

1.02 QUALITY ASSURANCE:

A. Contractor shall demonstrate the proposed microprocessor interlocking equipment has been successfully installed and in service on a minimum of 3 major transit systems in North America for a period of at least 2 years.

B. All devices shall meet AREMA safety requirements, Signal Manual Parts 11.5.1 and 2.2.12. Devices shall interface with LRC, MTSP, wayside pushbuttons, wheel detectors, and signal equipment currently in use in the North Ave. Yard.

C. Factory test each microprocessor system prior to installation in accordance with manufacturer's test procedures and the provisions of Section 17251.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

Contractor shall submit the following to the Administration for approval prior to manufacture or procurement of the equipment. The risk of procuring or producing any hardware or software shall belong to Contractor until such items are approved by the Administration.

A. Submit all mechanical and circuit drawings for microprocessor interlocking system components (CDRL). Submit field test procedures for a microprocessor interlocking system (CDRL). Submit estimated MTBF

for the system (CDRL). Submit transmission method for serial data (CDRL). Submit program language for approval (CDRL).

B. Submit factory test procedures for microprocessor interlocking system (CDRL).

C. Submit factory test reports for microprocessor interlocking system (CDRL).

D. Installation (CDRL).

E. Submit field test procedures for a microprocessor interlocking system (CDRL).

F. Submit field test reports for a microprocessor interlocking system (CDRL).

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G. Submit application software and software libraries for all processor driven devices.

H. Furnish to the Administration, one copy of all development and simulation software necessary for the creation, modification or design of any application dependent instructions including full instruction manual as provided by the software supplier (CDRL).

I. Submit as-built drawings, circuits for microprocessor interlocking system and associated equipment showing actual in-service conditions (CDRL).

1.04 DESIGN CRITERIA

A. Equipment cabinets and enclosures shall include all termination strips, interface hardware, wiring, cabling, etc. necessary to provide a complete operational interface between the enclosures and PLC equipment.

B. Equipment cabinets and enclosures shall include all components as shown and specified. Necessary accessories such as instrument loop power supplies, mounting hardware, terminal blocks, control circuit breakers, and other items required to complete the system shall be provided.

C. Control components such as relays, timers and other equipment necessary to provide the interfacing and interlocking required between the motor starter and associated protective circuits, or other type of control circuit function applicable to a particular final control element, shall be furnished pre-mounted and wired in the applicable enclosure.

D. Equipment cabinets and enclosures construction shall be compatible with the environment of the installed location and shall protect the enclosed instruments and equipment from ambient temperature extremes, moisture, dirt, dust, gaseous contaminants and normal physical abuse.

E. The elementary circuit diagrams shown on the Drawings illustrate some electrical schematics for major equipment associated with the enclosures. These schematics are to be considered typical of the equipment that is to be furnished. Provide engineering necessary to interface to the enclosures, prepare wiring schematics for equipment, provide all interconnections and put the enclosures in a complete operational status. Provide additional detailed engineering necessary to properly interface with equipment actually furnished. Any changes resulting from deviations from the typical schematics shall be furnished with no increase in scope or cost.

F. Equipment cabinets and enclosures design shall allow for removal and maintenance of equipment after installation.

G. Equipment cabinets and enclosures mounted nameplates shall be furnished to properly identify all enclosures and the equipment mounted on the enclosure front. A final list of nameplates to be used and a location drawing shall be submitted to the Engineer for review. Nameplates shall be laminated plastic having black letters on white background and shall include device identification number as well as a descriptive name. Nameplates shall be permanently secured by stainless drive screws.

H. Back-of-panel mounted plastic markers, with black letters on a white background shall be used in the enclosure interior to identify each device mounted on the enclosure exterior or interior. The markers shall be located adjacent to, but not on, the given device and visibility shall not be obstructed by wire bundles or other equipment. Markers shall include device identification number as well as descriptive name.

I. Provide for the protection, insurance and proper storage of equipment. Patent defects in the equipment shall be repaired or replaced, as required, at no cost to the Administration, until substantial completion. Any latent defects that are found shall be immediately brought to the attention of the Engineer.

J. Equipment will be installed in strict accordance with the manufacture's recommendations. Use the manufacturer's installation manuals for guidance and for details not shown on the Drawings.

1.05 MODIFICATIONS OR UPGRADES:

A. Any modifications or upgrades to solid-state equipment provided by Contractor or its suppliers shall also be made to equipment already

delivered to the Administration. Such modifications or upgrades shall be made until the end of the guaranty period.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Units shall be plainly marked with manufacturer's references.

B. Loose pieces shall be packed separately, but firmly attached to the product.

C. A detailed list of packages and their contents shall be provided for all shipments.

D. Microprocessor interlocking system equipment and their component parts shall be protected against damage and loss during handling and shipment.

PART 2: PRODUCTS

2.01 GENERAL:

A. Lightning protection and surge suppression devices shall be provided in accordance with manufacturer's standard and Section 17173. Protection against lightning, surges, spikes, or over-voltage shall be provided. All input and output lines, and all auxiliary equipment shall be protected.

B. Microprocessor interlocking system equipment shall be capable of operating in temperatures of -40°F to +160°F, without heating or cooling enhancements such as fans or heating strips.

2.02 HARDWARE AND OPERATING REQUIREMENTS: Microprocessor interlocking system shall meet the following requirements:

A. Based upon solid state microprocessor technology and shall not require any off-line storage devices for operation or startup.

B. There shall be two PLCs, one normal and one standby both shall share I/O.

C. PLCs shall be located in the South CIH. Remote I/O devices shall be located in the North CIH and the 94N CIH. PLCs, Remote I/O units and LRC equipment room shall be connected with a fiber cable ring as shown.

D. Each microprocessor unit shall consist of a single processor with CPU(s), I/O ports and memory, printed circuit boards and associated cables, plugs, wire connectors, terminal boards, data transmission equipment, power

supplies, power conditioning equipment, instrument racks and hardware, and use closed loop feedback and continuous self-checking to maintain operational integrity.

E. Each PLC shall be powered by two dedicated power supplies.

F. I/O shall have its own power supplies independent of the PLC power supplies.

G. Power supplies for the PLCs and I/O shall be 24 VDC or 12 VDC.

H. All parts for solid state equipment shall be available for a minimum of 10 years.

I. All plug connectors, data transmission equipment, power supplies, power conditioning equipment, terminal boards, wire connectors and other equipment required to achieve a complete stand alone subsystem shall be mounted within the instrument rack along with the associated microprocessor units.

J. Hardware interface board shall indicate status of each input or output.

1. An LED shall be provided on all input boards for each input to indicate when the input is activated.

2. An LED shall be provided on all output boards for each output to indicate the output is activated.

K. Inputs and outputs shall consist of local interlocking functions or by serial inputs and outputs. The local interlocking functions, shall be provided with a sufficient number and type of non vital printed circuit boards to allow the following:

1. Pushbutton LED drivers:

a. Shall directly drive wayside pushbutton indications without any interfacing relays.

b. Each LED shall be continuously cycle checked for an open or shorted condition. Upon detection of an open or shorted condition, the system shall provide an alarm visible on the MTSPs.

c. Upon detection of a controller shutdown, the system shall display a dark indicator on all pushbutton indicators.

2. System shall be capable of monitoring power switch machines from indication relay contacts interfaced to the I/O.

3. Input and output printed circuit boards shall interface with wheel detector zones by using wheel detector output relays.

4. System shall be capable of monitoring inputs to determine whether they are flashing. The system shall accomplish this by considering an input that is present less than 2 seconds as flashing.

5. The PLCs shall directly interface with MTSP and alarm circuits.

L. PLCs shall be provided with serial ports to allow serial communications with remote I/O units and Light Rail Control.

M. Microprocessor unit shall be provided with non-vital serial ports to accomplish non-vital communication of data between the microprocessor and MTSP and either separate non-vital microprocessor or the unit's own non-vital processor. All non-vital data communications shall conform to RS-485 or Ethernet standards. In addition, a serial communications data port conforming to RS-485 standards shall be provided for connection of portable computer test equipment to facilitate the running of diagnostic software for maintenance and testing purposes and for downloading of data for maintenance analysis away from the equipment location.

N. Printed circuit boards shall be housed within a card file and be plug in type. Means shall be provided on the card file to prevent insertion of improper printed circuit board types.

O. Card files shall be factory mounted in a standard 19-inch instrument rack per AREMA Signal Manual Part 2.2.12. All wire connections to the card files shall be via plug connected cables.

P. Sufficient input/output terminals shall be provided on the rack for all required functions. In addition, I/O shall be provided to allow the inclusion of existing track circuits in the yard not yet in service as well as an additional spare capacity of 10 percent.

1. I/O shall be powered from two dedicated power supplies independent of CIH power for each voltages the I/O requires.

2.03 EXECUTIVE AND APPLICATION SOFTWARE:

A. Operating instructions for the non-vital microprocessor system shall be divided into executive and application dependent portions. Executive functions shall be stored in Flash Memory devices and called the

executive software. The application's dependent instruction shall be stored in Flash Memory devices and called application software.

B. Executive software shall continuously test for a loss of control over the state of hardware outputs, a loss of control over RAM, a loss of data communications, and a spontaneous change in Application Software.

C. Executive software shall log all non-vital failures and identify the faulty printed circuit board.

D. Executive software shall supervise a closed loop monitoring system for all hardware input and output functions. The log entry shall contain the date, time, and status of all input and output status for a minimum period of 168 hours.

E. All functions required for system integrity evaluation, error logging, hardware interface, timing, data communications, application logic execution, and the application of power to the non-vital controller shall be fully interleaved and executed by a single microprocessor. Failure to pass any system integrity tests shall cause the system to cease all data communications and remove power, in a manner similar to a vital system, from all hardware outputs such that the signaling system assumes the most restrictive state.

F. Application software shall define operation of the interlocking system as specified. All control functions shall be accomplished using application logic that while being non-vital emulates vital logic.

1. Application logic functions include, but not be limited to:

a. Route Check.

b. LED Out Function and Detection.

c. Route Locking.

d. Detector Locking.

e. Time Locking

f. Power off Locking.

g. Switch Control.

h. Switch Indication.

i. Switch Correspondence.

j. Switch Request and Indication.

k. Pushbutton Request and Indication.

l. MTSP Control Mode Request and Indication.

m. Existing switch pushbutton request and indication.

n. Switch Block Request and Indication.

o. Track Block Request and Indication.

p. Track Occupancy Indication.

q. Alarm Indication.

r. Route Indication.

2. Application software shall be written and complied using a language that enables system logic to be expressed in terms familiar to signal personnel using logic circuit diagrams. Such language shall be approved by the Administration prior to software development.

3. All application specific logic in any signal related equipment shall be capable of modification by Administration personnel. Contractor shall provide all material, software and hardware for the creation and modification of site-specific application software. Such material shall include source codes and software libraries necessary for the creation or design of any application dependent instructions, together with any editors, compilers, linkers, loaders, verification and validation tools, or other utilities.

4. Contractor shall provide a complete detailed program printout of all application software for each microprocessor unit.

5. Program shall be modularized in a logical and easily understood manner.

6. Each module shall be fully documented with a plain English explanation of its purpose and the method by which such purposes are accomplished, the modules to which it is related and the modules of which it is a part and shall be fully annotated such that purpose can be logically followed and inputs and outputs have descriptive nomenclature.

2.04 MICROPROCESSOR I/O CONFIGURATIONS:

A. Microprocessor interface to LRC shall consist of but not limited to the following I/O arrangement:

1. Signal Controls (Outputs):

   a. Interlocking Pushbutton Display Request.

   b. Interlocking Pushbutton Cancel Request

   c. Switch Machine Request Normal.

   d. Switch Machine Request Reverse.

   e. Light Rail Control/MTSP Mode, existing switch pushbutton mode.

2. Indications (Inputs):

   a. Track occupied.

   b. Interlocking Pushbutton Request.

   c. Interlocking Pushbutton Displayed.

   d. Switch Machine Normal.

   e. Switch Machine Reverse.

   f. Switch Locked.

   g. Light Rail Control/MTSP Mode, existing switch pushbutton mode.

   h. Power Off Alarm.

   i. Microprocessor Status.

3. Communication and Environmental Indications:

   a. High temperature alarm.

   b. Low temperature alarm.

c. HVAC failure alarm.

2.05 SAFETY:

A. The Microprocessor interlocking functions shall be designed using closed loop principle to achieve safety.

B. Erasable portion of memory must have appropriate physical or electrical protection to prevent unauthorized or accidental changes.

C. Software revisions shall be verified through validation and verification to prevent accidental or unintentional changes.

D. All portions of memory containing software routines must be in a sealed or otherwise verifiable and protected package.

E. All software must have complete identification on the individual flash memory or other storage device to prevent application of programming to the wrong location.

F. Simulation tools shall be provided to test main system logic before actual field installation. Simulation tools shall be configured to simulate both normal and abnormal situations. They shall provide sufficient time to allow the status of the software variables to be confirmed in a controlled manner.

G. Microprocessor unit shall be equipped with onboard diagnostics to detect failed printed circuit boards or other hardware. Operation of any diagnostics that may change software routines or otherwise compromise safety shall be accessible only through a hardware or software security system.

2.06 ENCLOSURES

A. Equipment enclosures shall be freestanding steel enclosures with steel 12-inch floor stands.
   1. Enclosures shall be fabricated from sheet steel meeting NEMA 4X requirements. Single door enclosures shall be fabricated with 12-gauge sides, top and back. Double door enclosures shall be fabricated with 10-gauge back and 12-gauge top and sides.
   2. Exterior welds shall be ground and sanded to a smooth finish free of burrs. Surfaces shall be free of ridges, nuts, bolt heads and similar protrusions.
   3. Removable lifting lugs designed to facilitate rigging and lifting of the enclosure during installation shall be provided on the top of the enclosure. Plugs shall be provided to fill the lifting ring holes after installation is complete.

4. A full-length door shall be provided for the front or rear access. The handle mechanism shall be furnished with a three-point latch. A key locking mechanism shall be provided.
5. Enclosures mounted outdoors or in unheated areas shall be provided with thermostatically controlled heaters that will maintain the inside temperature above 40 degrees F.

B. Enclosures shall be designed, manufactured and tested in accordance with the latest applicable standards of NEMA, IEEE, and ANSI.

C. The enclosures shall have sufficient structural reinforcements to insure a plane surface, to limit vibration and to provide rigidity during shipment, installation and operation without distortion or damage to the enclosure or injury to any instruments mounted thereon. Seams are to be continuously welded.

D. Enclosures shall be fully enclosed units with front and/or rear access doors as necessary, and designed to fit in the space available. After completion of construction and installation of all enclosure mounted devices, there shall be no holes or knockouts remaining except for power wiring entrances, signal and communication wiring entrances, and mounting holes for future enclosure mounted devices. Knockouts for the wiring shall be on sides of the enclosure whenever possible. Holes for future devices shall be covered with a plastic plate.

E. Freestanding steel enclosures shall be bonderized, primed and finished with two coats of ANSI enamel finish on exterior surfaces. Wall mounted steel enclosures shall be bonderized, primed and finished with two coats of ANSI polyester powder finish on interior and exterior surfaces. The enclosure interior shall be white. The exterior color shall be selected by the Engineer at the time drawings are submitted for review.

F. Each enclosure shall have print pockets mounted inside the door, which shall hold detailed wiring and interconnection diagrams for the enclosures. One copy of the relevant record drawings shall be provided and placed in these pockets. A locking door handle shall be provided for each enclosure. Locks shall be keyed alike.

G. NEMA Type 4x enclosures shall be provided. A continuous gasket shall be provided around the door opening. A locking door handle shall be provided for each enclosure. Locks shall be keyed alike.

H. Enclosures shall be furnished with vapor-base protective corrosion inhibitors, Hoffman A-HCI-5E, 10E, or equal. The inhibitor shall be activated upon delivery to the site. Enclosures shall not be stored with inhibitors inactive. If necessary, enclosures shall be covered to reduce ventilation and prolong inhibitor life.

I. Steel stiffeners shall be provided on the back of the enclosure face as required to prevent deflection due to instruments, operations of equipment, or opening/closing of doors. As a minimum use 0.25 inch high by 1 inch wide by 0.5 inch deep channel stiffeners and tack welded to the enclosure. Where enclosure mounted instruments require rear mounting support, provide support brackets per the manufacturer's recommendations.

J. Internal condensation and freezing protection with thermostat control shall be provided for enclosures mounted outdoors or in unheated areas.

K. A master circuit breaker and branch circuit breakers on each individual circuits shall be provided. Circuit breakers shall be grouped on a single subpanel with a clear view of and access to the breakers when the enclosure door is open.

2.07 ENCLOSURE WIRING AND TERMINATIONS

A. Wiring and terminations shall be designed, manufactured and tested in accordance with the latest standards of the National Electrical Code as well as state and local electrical codes for the area where the enclosures will be installed.

B. Enclosure Wiring

1. Instrumentation and Communication Signal wiring shall be segregated from control power wiring, grouped functionally and arranged neatly to facilitate tracing of circuits.
2. Plastic wiring wraps shall be used to bundle wires, except within wiring ducts. The bundles shall be securely fastened to the steel structure at suitable intervals, not exceeding 12 inches in length.
3. Where shielding is required, shields shall be continuous foil or metalized plastic providing 100% coverage. A drain wire in continuous contact with the shield shall be included.
4. The wiring for AC signals and the wiring for DC signals shall be segregated as much as possible within the enclosure. They shall be bundled in separate bundles. The running of DC signal wiring and AC signal wiring in a common duct or panduit shall be kept to a minimum.
5. Enclosure wiring shall be as specified in Articles 17221-2.01.E for Interior Wire and Cable, 17221-2.02 for Power Cable, 17221-2.03 for Communications Cable and 17221-2.05 for Fiber Optic Cable.
6. Wiring shall not be spliced. Wire shall run in continuous lengths from screw terminal to screw terminal. Wire service loops shall be provided to permit device removal.
7. Wires shall be identified at both ends with white sleeve-type markers. The wire markings shall correspond to the wire designation shown on the enclosure wiring drawings.

8. In enclosures where foreign voltages exist, furnish a highly visible warning label inside the enclosure with the following words: "WARNING: FOREIGN VOLTAGES EXIST IN THIS ENCLOSURE. THEY ARE IDENTIFIED BY YELLOW WIRE COLOR."

C. Terminal Blocks

1. Terminal blocks shall be provided for interconnection between field devices and enclosure wiring. The terminal blocks shall be factory assembled on a mounting rail and the rail bolted to the inside of the enclosure. Center to center spacing of terminal block strips shall not be less than 6 inches for low-density terminal blocks and 8 inches for high-density terminal blocks.
2. Terminal blocks shall be of the screw type with pressure plate (compressor type) requiring no lugs on connecting wires. Terminals shall accept wire size 14 AWG or smaller and shall be suitable for 600 volts service. The terminals shall have continuous marking strip, using the alphanumeric nomenclature. Separate terminals shall be provided for terminating shield wires.
3. One side of each terminal strip shall be reserved for field incoming conductors. Common connections and jumpers required for internal wiring shall not be made on the field site of the terminal. No more than two wires shall be terminated at any one terminal.
4. A minimum of 25% spare mounting rail length shall be installed. Spare terminal blocks shall be mounted of type and quantity equal to the points on one I/O card of each type used in that enclosure.
5. Two ground buses shall be provided in each enclosure, one for shield and enclosure grounding and one for signal grounding. Grounding lugs for each connection to the external grounding system shall be provided.
6. High density terminal blocks and fuses for AC and DC signals shall be Phoenix Contact, Weidmuller, or equal.

2.08 ENCLOSURE MOUNTED DEVICES

A. Back-of-panel devices shall be arranged in a neat and orderly fashion with provisions made to allow addition of future equipment, where required.

B. Signal Converters

1. Condition and convert all signals to insure their compatibility with the enclosure functions and the system interface. Converters required for conditioning any signals from existing instruments that are inputs to the system shall be furnished.
2. Signal converters shall be of the same manufacture. Power requirements shall be the manufacturer's standard and shall be provided by a source in the enclosure if different from 120 VAC, 60 Hz.
3. Plug-in card file configurations or individual surface mounted

devices are acceptable. Accuracy of each device shall be 0.1 percent of span or better. Ambient temperature effects shall not contribute more than 0.5 percent of span error over a temperature range of 0 to 50 degrees C. Voltage source variations of 10 percent shall not contribute more than 0.1 percent of span of error.

4. Calibration adjustments, zero and span adjustments, deadband adjustments, etc., shall be provided on converters where applicable via a calibrated dial. Input and output signals shall be isolated.
5. Terminations for input, output and power wiring shall consist of screw terminals located on the converter body.
6. Signal converters shall be AGM Electronics 4000 Series, Transmation 3000 Series, or equal.

C. Interposing Relays: As describe4d in Section 17171

D. 24 VDC Power Supply

1. Enclosures containing 4-20 mA analog loops shall be provided with a 24 VDC power supply to provide DC power to the equipment as necessary.
2. The power supplied shall meet or exceed the following specifications:

a.	Input Power:	85 to 132 VAC, 60 Hz + 3 Hz
b.	Minimum Efficiency:	75 Percent
c.	Overload Protection:	Current limited to a preset value
d.	Operating Temperature Range:	0 - 60 degrees C
e.	Mounting:	Surface mount
f.	Output Voltage:	24 VDC + 5 Percent adjustable
g.	Output Voltage Regulation:	0.8 Percent from 0 to full load
h.	Ripple and Noise:	20 mV RMS, 200 mV peak to peak
i.	Temperature Coefficient	0.02 Percent per degree Centigrade

2.09 POWER DISTRIBUTION

A. Feeder circuit conduit entry shall be provided for with a terminal board for termination of the wires.

B. A master disconnect switch and branch circuit breakers on each individual circuit distributed shall be provided. The circuit breakers shall be grouped on a single rail. They shall be placed so that there is a clear view of and access to the breakers when the door is open. Branch circuit breakers shall be rated as shown on the Drawings.

C. Power shall be supplied to each PLC enclosure from the appropriate

distribution panel as shown on the Drawings. Terminal strips shall be provided in the enclosures for 120 VAC supply power distribution. All RIO enclosures associated with a particular PLC shall be powered from this distribution terminal strip.

2.10 POWER LINE TRANSIENT PROTECTION

A. Enclosures containing solid-state electronic equipment shall be provided with line voltage surge suppressors to protect the equipment from damage due to electrical transients induced in the interconnecting lines from lightening discharges or nearby electrical devices. The line voltage surge suppressors shall be Control Concepts Corp. "ISLATROL/IC" Series, Transector ACP 100BW3 or equal.

B. Power line surge suppressors shall be provided which include a surge arrester, RFI filter, voltage clamp, and terminals for incoming and load wires and which shall not trip power feed circuit breakers. Device reset shall be automatic.

C. An individual quality unit rated for continuous duty shall be provided which meets the following requirements.

1.	Power:	120 VAC, 60 Hz.
2.	Response Time:	Less than 5 nanoseconds.
3.	Transient Reduction (Normal and common mode)	30 db attenuation to IEEE 587, category B 6 kV impulse.
4.	Operating Temperature:	- 40 to 70 degrees C.

D. An external single point ground shall be provided.

PART 3: EXECUTION

3.01 MOUNTING:

A. All components of each microprocessor unit shall be mounted in a single instrument rack. All wire connections to card-files shall be via plug-connected cables.

B. Mount PLCs and Remote I/O units in locations per the approved design.

3.02 IDENTIFICATION:

A method as approved by the Administration shall be used to mount a typed or printed nametag for each microprocessor interlocking system card-file/cabinet on the front plate of the cabinet. Nametag shall be easily replaceable, but not come off during normal service.

3.03 WIRE AND CABLE INSTALLATION

A. Install all wire and cable connections to and between PLCs and Remote I/O units in all CIHs for power and data.
B. Install overhead cable supports from CIHs to shop building for fiber optic cable connections to LRC equipment room.
C. Install conduits on and in the shop building per the approved design for fiber optic cable connections to LRC equipment room.
D. Install fiber optic cables and termination equipment, between PLCs, Remote I/O units and LRC equipment room to form a complete loop as shown.

3.04 TRANSIENT VOLTAGE SURGE SUPPRESSION (TVSS):

A. Contractor shall provide grounding, bonding, and TVSS devices, materials and wiring to prevent damage to equipment from atmospheric lightning strikes and conducted transient voltage spikes – see also Section 16289.

B. All equipment shall be provided complete with necessary isolation and power regulation devices to ensure proper performance and reliability. Design, fabrication and installation shall be such as to make it immune from noise and transients. Solid state equipment shall be immune to electrostatic discharges to all devices and surfaces exposed to human touch during operation or servicing.

3.05 TESTING:

The microprocessor interlocking system shall be factory and field tested in accordance with Section 17251 and as recommended by the manufacturer. Contractor shall furnish all necessary testing devices.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. The microprocessor interlocking system shall be measured on a lump sum basis including all system elements described herein plus those described in Sections 17103, 17171, 17173, 17175, 17177, and 17263 and associated wire and cable described in Section 17221.

4.02 PAYMENT:

A. Payment for the microprocessor interlocking system installed in place with all components for a complete operational system including those listed in

Article 4.01.A above will be paid for at the lump sum price for Microprocessor Interlocking System.

END OF SECTION

SECTION 17211

PUSHBUTTON FOUNDATIONS

PART 1: GENERAL

1.01 DESCRIPTION:
This Section includes specifications to furnish and install foundations for route request pushbuttons in the North Ave. Yard.

1.02 QUALITY CONTROL:

A. Factory test all foundations in accordance with procedures as specified in section 01450.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with section 01300.

A. Submit manufacturer's product literature and specifications of Foundations for approval (CDRL).

B. Submit shop drawings for Foundations (CDRL).

C. Submit installation drawings for Foundations (CDRL).

D. Submit as-built drawings for all Foundations (CDRL).

1.04 DELIVERY, STORAGE AND HANDLING:

A. Precast concrete foundation units shall be handled with care to avoid damage in transit and at storage locations. They shall be adequately supported, cushioned and stacked to protect all edges of the units. Any chipping, cracks or other damage caused by mishandling of the units shall be the Contractor's responsibility. Defective foundations shall be repaired or replaced as directed.

PART 2: PRODUCTS

2.01 FOUNDATIONS:

A. All foundations shall be precast concrete types. Cement, aggregates, mixing water and reinforcement used for precast foundation units shall conform to the applicable requirements specified in the current edition of the AREMA Manual for Railway Engineering. Precast concrete foundations shall be made of concrete of minimum compressive strength of 4000 psi.

B. Foundations shall be provided complete with anchor bolts, nuts and washers, all in accordance with the applicable portion of Part 14.4.1A of the AREMA 2012 Signal Manual.

C. Foundation height shall be as shown on the Bid Documents and shall be appropriate to the size, weight and configuration to be mounted.

D. Pre-cast concrete foundations for wayside signal equipment shall be as specified below or equivalent.

1. Pushbutton, (Dixie Precast, Model DPS –1A).

PART 3: EXECUTION

3.01 INSTALLATION:

A. Foundations shall be installed in accordance with the installation drawing approved by the Administration for that purpose. All foundations shall be vertical as installed.

B. Contractor shall provide properly crushed stone base for all foundations installed in ballast track areas under this contract.

C. When placing these foundations, the Contractor shall exercise due care to ensure the anchor bolts are not bent or threads damaged. All anchor bolt threads, washers, and nuts shall be protected by applying friction tape, or by some other method satisfactory to the Administration, until such time the signal equipment is installed.

D. Contractor shall coordinate with the Administration to determine the final location of the foundation in the field to insure that they do not interfere with other apparatus such as manholes, conduits, catenary poles, and utility pipes.

E. Excavate to an appropriate depth and prior to installation of the foundation, place a 6 inch minimum layer of 1.5 inch maximum sized washed gravel in the bottom of the hole.

F. Remove soft or unsuitable material existing below the required subgrade and replace with compacted gravel. Remove rocks or boulders below sub-grade to a minimum of 1 foot below the bottom of the foundation.

PART 4: MEASUREMENT AND PAYMENT

4.01 PUSHBUTTON - FOUNDATIONS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17215

GRID LAYOUTS AND GROUNDING SYSTEMS

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes the requirements for grounding of signal equipment.

1.02 QUALITY ASSURANCE:

A. Contractor shall inspect each grounding system as installed and correct any deficiencies.

B. Testing of the grounding systems shall be conducted as specified in section 17251, Tests and Inspection.

1.03 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit manufacturer's product and specifications of bonding material and equipment for approval.

B. Submit a grounding arrangement plan for the required grounding of all signal equipment (CDRL).

1.04 DESIGN CRITERIA:

A. Provide a grounding system at each pushbutton location and for other signal equipment as specified herein.

1. Grounding methods shall be designed to minimize the noise voltage generated by currents from 2 or more circuits flowing through common ground impedance and to avoid creating ground loops, which are susceptible to magnetic fields and differences in ground potential. Safety considerations requires the chassis or enclosure for electrical equipment to be grounded in order to minimize shock hazards, except in cases where a safety ground may be desirable at a point which would be unsuitable for a signal ground.

2. Design grounding equipment to accomplish the following, as a minimum:

a. Protect personnel and equipment from electrical hazards, including lightning, to the extent acceptable.

b. Reduce potentials to grounding equipment neutrals.

c. Reduce or eliminate the effects of EMI and electrostatic interference arising within the signal system.

d. Provide a single point grounding system for all equipment enclosures, cabinets, drawers, assemblies, and subassemblies (chassis/cabinet).

3. The following guidelines shall be applied to grounding:

a. For all indoor and outdoor equipment requiring grounding, the grounding systems for all enclosures or structures shall be designed to provide proper terminations for shielding and avoid conducted coupling, low impedance ground loops, and hazardous operational conditions.

b. All ground wires shall be sized in accordance with NEC requirements to provide an adequate conduction path for all possible fault and interference currents.

c. A single point ground wire shall not carry load currents.

d. Ground equipment racks and cabinets as specified herein.

e. A grounding plan to be approved by the Administration.

B. Wayside signal locations shall require at least 1 ground rod.

C. Test and measure ground resistance as specified in Section 17251. Use as many ground rods as necessary to develop an earth ground of a maximum of 5 ohms or as approved by the Administration.

D. Use of drilled holes with ground enhancement materials and electro-chemical grounding systems shall be applied as required, in lieu of the specified driven rod grounding, to attain the specified value.

E. Bonding:

1. Design and implement bonding to accomplish the following:

a. Prevent static charge accumulation that could produce electromagnetic interference or constitute a shock hazard to personnel.

b. Provide a homogeneous and stable ground plane.

c. Provide a fault current return path.

d. Prevent spurious development, rectification, and intermodulation of potentials between hardware elements.

2. Bonding shall be implemented through direct metal-to-metal contact. Continuous or multi-point bonding shall be preferred over single contact to reduce the concentration of high current densities at the point of contact.

3. The following guidelines shall be applied to bonding:

a. Clean all bare metal mating surfaces.

b. Where possible, weld all mating surfaces.

c. Where protective films are required, use film material with high conductivity, such as silver or gold plating.

d. Fastening methods shall exert sufficient pressure to hold the surfaces in contact, in the presence of deforming stresses, shock, and vibrations associated with the equipment and its environment.

e. Paint shall not be used to establish electrical bonds.

f. Ohmmeters shall not be used to evaluate RF bonds or RF gaskets.

g. Bonding of dissimilar metals shall be analyzed as to galvanic and electrolytic action.

h. Ground resistance shall be checked at the single point ground in each CIH, case and wayside device to ensure that resistance to the single point ground does not exceed 0.5 ohm, and that resistance to ground is below 5 ohms, or as approved by the Administration.

i. Ground connection to the neutral conductors of the local power utility company is prohibited.

F. Ground cable from CIH, case and other wayside signal equipment locations to ground grid/rods shall be hidden as much as possible to prevent being vandalized.

G. Ground rod to cable connections shall be by exothermic welding.

H. Wayside push-button locations shall require a connection to the nearest running rail. This connection shall meet the same requirements as a ground connection, except that the wire shall be insulated with 1000 volt rated insulation.

PART 2: PRODUCTS

2.01 GROUNDING AND BONDING MATERIALS:

A. Grounding and bonding materials shall be as specified in Section 17015.

PART 3: EXECUTION

3.01 INSTALLATION REQUIREMENTS:

A. Work shall be arranged in such a manner that each part of the grounding system which is laid below finished grade shall be completed, inspected and tested before backfilling is done. All precautions shall be taken to assure that no damage is done to grounding and bonding conductors or connections during backfilling, compacting and concreting operations. Testing for ground resistance shall be before any finish surfacing is laid above the grounding and bonding conductors.

B. Subgrade grounding connections shall be of the exothermic heavy-duty type, except where otherwise noted in the Bid Documents. Conductors, rods and molds shall be prepared in accordance with the manufacturer's instructions before making these welds. Brazing as approved by the Administration may be used where exothermic welds are not practical.

C. Ground tap connections to equipment shall be made at the points provided on the equipment for grounding, in accordance with the manufacturers' recommendations. Where ground pads are not provided, equipment or structures shall be drilled and connections made by means of a ground wire clamp with bolts and nuts, or the equipment or structure drilled and tapped and connected by means of a capscrew or post-type connector, as approved by the Administration. All paint, scale, rust, oxidation, or other foreign material shall be thoroughly removed from the points of contact on all metal surfaces before any ground connections are made.

D. Metallic conduit systems, whether embedded or exposed, shall be electrically continuous and thoroughly grounded. Wherever slip joints are used, suitable bonding shall be provided around the joint to insure a continuous ground circuit. Metallic boxes shall be grounded to the bonding conductor, preferably by compression-type terminals bolted to boxes, unless conduit connections to the box are threaded and the

grounding conductor is brazed to the box. Screwed and brazed joints shall be carefully painted with bituminous paint.

PART 4: MEASUREMENT AND PAYMENT

4.01 SIGNALS –GRID LAYOUTS ANDGROUNDING SYSTEMS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17221

WIRE AND CABLE

PART 1: GENERAL

1.01 DESCRIPTION: This Section includes specifications to furnish, install and test all signal and communication cables and wires required by this Contract.

1.02 QUALITY ASSURANCE:

A. Manufacturer Qualifications: 15 years of documented experience in supplying cable to the railway or transit industry for use in installations similar to those required by this Contract. A certification letter is required.

B. Cables and wires to be provided and installed by the Contractor shall meet the requirements of various standards, as described throughout this section. The referenced standards organizations include the following:

1. American Railway Engineering and Maintenance of Way Association (AREMA) Signal Manual of Recommended Practices.

2. Insulated Cable Engineers Association (ICEA).

3. National Electrical Manufacturers Association (NEMA).

4. American Society for Testing and Materials (ASTM).

5. National Electrical Code (NEC).

C. Cable Tests and Administration Inspection: The Contractor shall provide, at the point of production, apparatus and labor for making any or all of the following tests under the supervision of the Administration or an appointed representative. Such tests shall include:

1. Voltage and insulation resistance tests on cables in accordance with paragraphs 6.24 and 6.25 of ICEA T-27-581, modified as follows:

a. Test potentials for both AC and DC as specified herein.

b. All immersion tests after 24 hours minimum immersion.

c. Individual conductors of multiple conductor cables tested before assembly as specified for single conductor cables.

2. Shield isolation test on all combinations of pairs and over-all shield. After 1 minute at 500 volts, the minimum resistance shall be 0.1 mega-ohms per foot.

3. Conductor resistance test on all cables in accordance with ICEA T-27-581, Part 6.

4. Physical characteristics tests on at least 1 sample from each type and size of cable in accordance with ICEA T-27-581, Part 6.

5. AC voltage withstand test on each shipping reel of finished cable at the test insulation voltage for 1 minute prior to shipment.

1.03 SUBMITTALS:

A. Drawings (CDRL):

1. Shop drawings and manufacturer's literature showing details of fabrication, and technical data for each type of cable to be furnished.

2. Cable plan showing the locations, cable routing, trough usage and functions of all cables to be installed along with the number and size of the conductors.

B. Test reports for all tests (CDRL) including:

1. Appropriate factory test data on file for each similar type and size cable for each step in the manufacturing process and tests performed on samples in compliance with the referenced standards.

2. Field tests after installation.

C. 24 inch sample of each type of cable to be supplied (CDRL).

D. Submit factory test procedures for all wire and cable (CDRL).

E. Submit factory test reports for all wire and cable (CDRL).

F. Submit field test procedures for all wire and cable (CDRL).

G. Submit field test reports for all wire and cable (CDRL).

1.04 DELIVERY, STORAGE, AND HANDLING:

A. Pack and mark wire and cable in accordance with AREMA Signal Manual Part 10.3.15, except as otherwise specified.

B. Ship, store, and handle material as specified in AREMA Signal Manual Part 10.4.1.

C. Seal cable ends to prevent entrance of moisture into the cable case during transportation, in storage and handling prior to final cable termination.

1.05 PACKAGING:

A. Stranded wire and cables shall be wound on reels or spools. Each reel or spool shall have an appropriate diameter for the respective wire size. In no case shall the barrel of the reel or spool have a diameter less than 50 times the nominal diameter of the wire for AWG 24 through AWG 14; 40 times for AWG 12 and AWG 10; 30 times for AWG 8 and larger, or less than 4 inches, whichever is larger. The reels or spools shall be finished to prevent corrosion under typical storage and handling conditions. The method of attachment of the flanges to the barrels on metal reels or spools shall be structurally equivalent to a full crimp.

B. The wire shall be closely and tightly wound in layers. All cable ends shall be securely fastened to prevent becoming loose in transit.

C. As appropriate, solid conductor wire shall be packaged on a 16-inch spool or in barrel packs to reduce wire curl.

D. Purchase order shall specify the requirements for the minimum continuous wire lengths acceptable and the number of continuous wire lengths permitted per reel or spool.

E. Each reel or spool shall be marked with weather resistant tags, identifying the amount of wire per continuous length and the number of lengths. In addition, the following information shall be included on the tags:

1. Purchaser's specification number.

2. Specification sheet number, if applicable.

3. Wire size and stranding.

4. Date of manufacture.

5. Name of manufacture.

6. Cable description, if applicable.

PART 2: PRODUCTS

2.01 SIGNAL WIRE AND CABLE:

A. General:

1. Cable with insulating and jacketing materials capable of a 40-year average service life.

2. Suitable for installation at minus 15 degrees C.

3. Capacitance of cables within the limits prescribed by the manufacturer of the equipment to which the cable is connected.

B. Minimum voltage rating for both AC and DC:

1. Track circuits and wheel detector cable: 2000 volts.

2. All other cables shall be rated for 600 volts minimum.

C. Conductors: Sized to ensure operation of the equipment based on the equipment loads and operating parameters for the systems in accordance with the NEC and as specified herein. Conductors of annealed copper wire in accordance with ASTM B33; Class B and Class C stranded conductors conforming to ASTM B8, Table 2; and Class G stranded conductors conforming to ASTM B173 shall be sized as follows:

1. Equipment module, signal, and instrumentation external wiring: No. 20 AWG minimum, Class B.

2. Rack to rack: No. 20 AWG minimum, Class B.

3. Wayside pushbuttons: No. 22 AWG minimum, Class B.

4. Wheel Detectors: No. 22 AWG minimum, Class B.

5. All other circuits: No. 14 AWG minimum, Class B.

D. Exterior Cables:

1. Except where interior type cable is specifically permitted, use exterior cable for all circuits operating at or above 120 volts AC/DC; and for all power, signal, control, and instrumentation

circuits installed along the wayside.

2. Certified for continuous operation at 90 degree C.

3. Insulation:

a. Single conductor cables and individual conductors of multiple conductor cables insulated with a tight fitting, clean stripping, and ozone resistant ethylene propylene rubber.

b. Average thickness of insulation not less than that specified below. Minimum thickness of insulation at any point not less than 90 percent of that specified.

1. Insulation thickness and test voltages of single conductor cable prior to jacket application for circuits rated up to 2000 volts is shown in the following table:

Conductor Size	Insulation Thickness in Mils	Test Voltage in kV	
		AC	DC
14 to 9 AWG	78	10	30
8 to 2 AWG	94	11	33
1 to 4/0 AWG	94	11	33
250 to 500 kcmil	105	12.5	37.5
750 to 1000 kcmil	105	12.5	37.5

2. Insulation thickness and test voltages for individual conductors of multiple conductor cables on circuits rated up to 2000 volts is shown in the following table:

Conductor Size	Insulation Thickness in Mils	Test Voltage in kV	
		AC	DC
20 to 18 AWG	45	5.5	16.5
16 AWG	65	8.0	24.0
14 to 9 AWG	78	10	30
8 to 2 AWG	94	11	33
1 to 4/0 AWG	105	12.5	37.5

c. Physical and electrical characteristics conforming to Table I when tested in accordance with ICEA T-27-581, Part 6, as modified herein.

4. Outer Jackets:

a. Single conductor cables and multiple conductor cables shall be provided with outer jacket of applicable material as follows:

Unless otherwise specified, jacket of extruded black low density, high molecular weight polyethylene material. Physical and electrical characteristics conforming to Type 1, Class C, Grade E5 of ASTM 1248 and Table II when tested in accordance with ICEA T-27-581, Part 6.

b. Average jacket thickness on single conductor cables shall be 65 mils minimum, and the average jacket thickness for the outer jacket on multiple conductor cables shall be in accordance with Table 4-18 of ICEA T-27-581. Minimum jacket thickness at any point shall not be less than 80 percent of that specified.

E. Interior Wire and Cables:

1. To be used only for wiring inside signal equipment houses and cases.

2. Certified for continuous operation at 239 degrees F (115degreesC) in wet or dry locations.

3. Conductors:

a. Stranded Conductors:

1. Conductors shall be soft or annealed copper wire for electrical purposes, per the latest revision of ASTM B-33 and B-3.

2. Strands and rope members shall be concentrically stranded using unilay (UNI), concentric (CON), and bunch (BUN) construction as specified in table below:

Conductor Size (AWG)	Stranding (NO/Size)	Strand Type	Conductor Nominal Diameter (mils)	(mm)	Nominal DC Resistance @ 20 Degrees C (Ohms/1000ft)	(Ohms/km)
24	19/36	UNI	23.6	.599	25.7	84.3
22	19/34	UNI	29.6	.752	15.8	51.8
22	7/30	CON	30.9	.785	16.9	55.4
20	19/32	UNI	37.8	.960	9.63	31.6

18	19/30	UNI	46.7	1.19	6.15	20.2
16	19/29	UNI	53	1.35	4.77	15.6
14	19/27	UNI	66.2	1.68	3.04	9.97
14.	37/30	CON*	71	1.803	3.05	10.0
12	37/28	CON*	87.2	2.19	2.02	6.63
10	37/26	CON*	110	2.8	1.26	4.13
9	37/019	CON*	129	3.27	.83	2.72
9	19x7/.010	UNI/ROPE	148	3.76	.88	2.89
8	19x7/29+	UNI/ROPE	162	4.11	.682	2.24
6	19x7/27+	UNI/ROPE	203	5.16	.433	1.42
4	19x7/25+	UNI/ROPE	257	6.53	.268	.879
2	19x35/30	CON/ROPE	331	8.41	.173	.568
1	19x43/30	CON/ROPE	360	9.15	.146	.479
1/0	19x55/30	CON/ROPE	418	10.6	.111	.364
2/0	19x70/30	CON/ROPE	464	11.8	.0872	.286
3/0	37x43/30	CON/ROPE	531	13.5	.0696	.228
4/0	37x57/30	CON/ROPE	598	15.2	.055	.180
500kcmil	7x19x38/30	BUN/ROPE	988	25.095	.022	.072

* Double Pass Concentric

4. Insulation:

a. The insulation material for stranded and solid conductor wires shall be modified ethylene tetrafluoroethylene (ETFE) per ASTM D3159-a, unless otherwise specified.

Insulation for stranded and solid wires:

1. All insulation for AWG 12 through AWG 24 shall be Tefzel 200 or equivalent. Tefzel HT-2127 or equivalent may be substituted for Tefzel 200 for enhanced flexibility.

2. All insulation for AWG 10 through 500 kcmil shall be Tefzel 280 or equivalent.

3. All insulation for the solid conductor wire wrap wire shall be Tefzel 750 or equivalent per UL Subject 758, Style 10125 and will include wire sizes AWG 26-30.

b. Wire Constructions:

1. The finished wire diameters, weights, and ampacity ratings are shown for 0-150, 0-300, 0-600, 0-1000, and 0-2000 volt rated stranded wires. All conductors shall meet the requirements in item 3.1 above.

2. The finished wire diameters and weights for 0-300 volt solid conductor wire are shown below. All conductors shall meet the requirements in item 3.2 above.

c. Insulation Thickness - Stranded and Solid Wires:

The nominal or average thickness of the insulation is in Table II in the back of this section. Minimum thickness at any point shall not be less than 90% per NEMA HP-100-1991, Section 3.2.

d. Wire Performance Requirements:

1. The insulation shall be applied directly to the surface of the specified conductors and shall adhere tightly to the surface, but shall be free stripping and shall leave the conductor clean.

2. The following tests shall be performed for each production run.

aa. Impulse dielectric or direct current spark test 100% of the wire per the following requirements:

	Impulse Dielectric Test Voltage KVAC (Peak)	DC Spark Test Voltage KVDC	
o	Wire rated 0-150V	1.5	3.0
o	Wire rated 0-300V	5.0	7.0
o	Wire rated 0-600V	6.5	12.0
o	Wire rated 0-1000V	8.0	16.0
o	Wire rated 0-2000V	10.0	20.0

3. The insulation must meet the aging requirements, heat distortion, insulation resistance, and dielectric constant (SIC) requirements of NEMA HP100.2-1991, Table 2-1 and the additional tests specified herein.

e. Color Coding of Wires:

1. Stranded Wires:

a). Cables of unpaired wires shall be solid color in the color sequence as shown below. The second color is achieved by using a stripe that is clearly identifiable and permanent.

b) Table - Color Code of Individual Wires of Multi-conductor Cables.

1.	Black	26.	Black/Violet
2.	Brown	27.	Black/Gray
3.	Red	28.	Black/White
4.	Orange	29.	Brown/Black
5.	Yellow	30.	Brown/Red
6.	Green	31.	Brown/Orange
7.	Blue	32.	Brown/Yellow
8.	Violet	33.	Brown/Green
9.	Gray	34.	Brown/Blue
10.	White	35.	Brown/Violet
11.	White/Black	36.	Brown/Gray
12.	White/Brown	37.	Brown/White
13.	White/Red	38.	Red/Black
14.	White/Orange	39.	Red/Brown
15.	White/Yellow	40.	Red/Orange
16.	White/Green	41.	Red/Yellow
17.	White/Blue	42.	Red/Green
18.	White/Violet	43.	Red/Blue
19.	White/Gray	44.	Red/Violet
20.	Black/Brown	45.	Red/Gray
21.	Black/Red	46.	Red/White
22.	Black/Orange	47.	Orange/Black
23.	Black/Yellow	48.	Orange/Brown
24.	Black/Green	49.	Orange/Red
25.	Black/Blue	50.	Orange/Yellow

c) In paired cables, one wire of each pair shall be white and the other wire shall be coded in accordance with the sequence of the first 21 wires given in table above, omitting the solid white. This color sequence shall be repeated as required to provide identification of all pairs.

5. Jacket:

a. Jacket of extruded block low density; high molecular weight polyethylene material shall be provided for:

1. Single conductor cables.

2. Outer jacket of multiple conductor cables.

b. Average jacket thickness on single conductor cables shall be 15 mils minimum.

c. Average jacket thickness for outer or overall jacket on multiple conductor cables shall be 45 mils minimum.

d. Minimum jacket thickness at any point shall not be less than 80 percent of that specified.

F. Assembly of Multiple Conductor Cables:

1. The number of spare conductors for all local multiple conductor cables shall be at least 10 percent, but not less than 1 spare conductor. Signal express cables shall be sized at a minimum of 24C #14 AWG working conductors and at least 6 spare conductors.

2. Exterior multiple conductor cables:

a. Assembled in accordance with AREMA Signal Manual Part 10.3.15,

Cables shall also have over the assembled conductors and fillers a shock-absorbing layer of moisture resistant extruded elastomeric material. The thickness shall be as follows:

Core Diameter (inches)	Ave. Cushion Layer Thickness
0 - 1.500	47 mils
1.501 & larger	62 mils

A pull cord shall be included beneath the cushion layer to provide for removal of the layer for terminating.

b. Exterior type cables including single pair twisted cable provided with a 10-mil minimum bronze tape beneath outer jacket for rodent and other environmental protection.

c. Additional shielding with metal tape or metal braid appropriate for installation and service conditions, and in accordance with ICEA T-27-581, Part 4, as required.

3. Twisted pair cable, and multiple twisted pair cables shall be assembled as specified above for multiple conductor cables.

4. Interior multiple conductor cable assembles in accordance with AREMA Signal Manual Part 10.3.15, except jacket as specified herein and fillers of flame resistant, non-wicking material.

G. Conductor Identification:

1. For twisted pair, the insulation shall be identified as white on one conductor and black on the other.

2. Except as otherwise specified, each insulated conductor in other multiple conductor cables shall be identified with a specific number or shall have a different color or tracer color combination.

3. Except as otherwise specified in referenced AREMA specifications, insulated conductors in other multiple conductor cables shall be black with one red conductor in each layer.

H. Identify cables as to manufacturer, year of manufacture, insulation type, conductor size, and voltage rating in accordance with manufacturer's standard method and subject to approval of Administration.

2.02 POWER CABLE:

A. The power cables for signal system instrument housings shall be sized to carry 125% the design loads and fault currents.

B. Cables shall be stranded copper conductors of minimum size #1/0 AWG (minimum 3C#1/0) and shall be ethylene-propylene-rubber insulated in accordance with ICEA S-68-516/NEMA WC8 and ASTM D-2802-78.

C. The insulation level shall be consistent with the system nominal voltage.

D. The cables shall be furnished with heavy-duty hypalon jacket and with galvanized steel interlocked armor tape listed by Underwriters Laboratories and in accordance with ICEA T-27-581.

E. Jacket thickness shall be as specified above in 2.01 D4b.

F. All power cables shall include a ground wire.

G. Power cable conductors shall be color coded per ICEA S-61-402 Appendix I.

2.03 COMMUNICATION CABLE: Minimum requirements for the cable shall be twisted pair No. 19 AWG cable. Conductor coating, insulation, inner jacket, metal tape armor, and outer jacket shall conform to the applicable requirements of ASTM, IEEE and ICEA.

2.04 ACCESSORIES:

A. All terminations and cable terminations shall meet or exceed the capacity and insulation voltage ratings of the wire or cable terminated.

B. All feeder cable and insulated wire runs shall be identified at each end of the run and also at all handholes, manholes and pull boxes. Wire identification markers/tags shall be water resistant, self-laminating vinyl with opaque-blank write-on section. Permanent ink markers shall be used to complete these tags. A transparent adhesive wrap shall be used to secure and protect the tag on the cable.

C. Wire ties shall be a heavy-duty nylon type strap, ultraviolet ray (sunlight) resistant with stainless steel locking barb sized to suit the application.

D. Insulating tape shall be black vinyl plastic with rubber based pressure sensitive adhesive. Tape shall be pliable at zero degrees F. Tape shall meet or exceed ASTM D 1000.

E. Arc-Proof Tape:

Flexible, conformable organic fabric, coated one side with a flame-retardant flexible elastomer-self-extinguishing, with the following minimum properties:

1. Thickness, ASTM D1000: 55 mils.

2. Tensile Strength, ASTM D1682: 50 pounds per inch.

3. Thermal Conductivity, ASTM D1518: 0.0478 btu/hour/square foot/degrees F.

4. Electrical Arc Resistance: Withstand 200 ampere arc for 40 seconds.

2.05 FIBER OPTIC CABLE:

A. Cable size shall be 12 fibers. Additionally the fiber optic cable shall be rated for interior and exterior installations and shall meet or exceed

the following specifications:

1. Tight-buffered cable, tube 62.5/125micron (core/cladding) multimode.

2. TIA -598 color-coding for fiber optic cable.

3. A central strength member of Kevlar™ yarn, capable of supporting a short-term tensile load of 400 lb. without stretching.

4. Capable of bend radii as small as 20 x outside cable diameter (under installation load) and 10 x outside cable diameter (long term load).

5. Capable of a minimum crush resistance of 850 lb. /in.

6. Fiber optic cable shall have impact resistance not less than 2000 impacts with 1.6 Nm.

7. Single armored fiber optic cable shall be double jacketed. Outer jacket shall have a wall width 1.5mm or more. Inner jacket with wall width 0.75mm or more.

8. Fungus-resistant, water-resistant immersed in standing water and UV-resistant for outdoor use.

B. Testing of the bidirectional attenuation of every fiber shall be done per EIA/TIA 256-14 or most current superseding document.

1. The FOC shall meet the Mechanical and Environmental conditions as specified by the latest EIA/TIA 455.

C. Color Coding

1. Fiber Optic: Each fiber in a tube shall be distinguishable from other fibers in the same tube by means of color-coding ink. Coating material shall be stable over the cable's operating temperature range. The coloring shall not be susceptible to migration and shall not affect the transmission characteristics of the optical fibers. The color coding, at the time of ordering the fiber optic cable, shall meet the conditions as mentioned in the most recent version of TIA/EIA.

2. BUFFER TUBE: At the time of ordering the fiber optic cable, each tube shall be colored completely and consistently in accordance with the present version of specifications in TIA/EIA-568.

2.06 FIBER OPTIC TERMINATION EQUIPMENT - FIBER DISTRIBUTION PANEL (FDP):

A. Each node of the SLAN shall provide access through FOC distribution panels, cable management trays and splice drawers. Minimum requirements are provided below:

B. Termination capacity: 12 fibers / 12 connectors for each end of FOC segment, total 24 fibers / 24 connectors. Termination capacity shall be enough to terminate 50% of two adjacent FOC segments into the same termination panel.

C. Mounting: 19 inch vertical rack mounted or DIN rail mounted.

D. Major Components: Termination / Patch Enclosure, Splice Enclosure, Splice Trays

E. Termination / Patch Enclosure:

1. Adapter panels for SC connectors (6 connectors per panel).

2. Minimum bend radius: design shall ensure that bend radius of fiber stored is more than 2 inches.

3. Access: Each tray with hinged access doors.

4. Patch cords: 8 patch cords per termination / patch enclosure

F. Splice Enclosure:

1. Splice enclosure shall have capacity to house 12 splices in trays.

2. 12 fibers per splice tray.

3. Splice tray type: Fusion.

G. Accessories: Provide necessary components for rack mounting or DIN rail.

H. Since the fiber will be field terminated, the Contractor may use a single box to manage the slack and serve as patch panel.

2.07 FIBER OPTIC TERMINATION EQUIPMENT - CABLE SLACK ENCLOSURE (CSE):

A. Provide cable slack enclosures at both cable entry/exit points of a SLAN node. Wall or surface-mounted type, aluminum construction, with ample space and brackets for coiled slack of up to 20 feet shall be provided. Bending radius of FOC in CSE shall exceed minimum

bending radius of FOC.

B. Knockouts and cable grommets at the bottom and top of enclosure of ample size to allow entrance of fiber optic cable.

C. Since the fiber will be field terminated, the Contractor may use a single box to manage the slack and serve as patch panel.

PART 3: EXECUTION

3.01 INSTALLATION:

A. Install signal system wire and cable in accordance with manufacturer's recommendation and applicable codes and standards.

B. Do not exceed minimum bending radius as specified in Section 17105 and as recommended by cable manufacturer.

C. Direct buried cable shall be installed at a minimum depth of at least 30 inches below sub-ballast and 30 inches below any sloped ground surface plane, or as required by local codes. Where this requirement cannot be met, cables shall be installed in conduits as specified in Section 17105. Prevent cable from coming into contact with sharp objects, and damage to cable insulation during installation. Notify the Administration 24 hours prior to cable installation.

D. Cables for signal system shall be installed at least 36 inches away from any high voltage cables such as substation cables to feed the catenary, local commercial power cables, or any cable required to carry current at 600 volts or more.

E. Verify that raceway conduit system is free of obstructions by pulling a suitable wire brush, swab, and mandrel through raceway conduit to remove extraneous matter.

F. Ensure that raceway conduit system is dry before installation of cable and use lubricant approved by cable manufacturer to facilitate pulling cable.

G. Determine maximum cable lengths and pulling tensions to avoid excessive pulling tensions or more bends than the manufacturer's recommendations.

H. Exposed cable will not be permitted along the wayside.

I. Do not allow wires to cross one another when pulled into a conduit. Prevent kinking in conduit fittings or boxes. All cables and wires to be

installed in a conduit shall be installed at the same time.

J. All temporary exposed wires and cables entering or leaving signal equipment housings, junction boxes, and cable transition points shall be protected from abrasion. Chase nipples shall be provided in drilled or punched openings in equipment housings and junction boxes located trackside. Openings in equipment enclosures and junction boxes shall have split ring plastic grommets.

K. Seal all openings in equipment enclosures and junction boxes where exposed cables enter the enclosure or box. A resilient sealing compound made expressly for the purpose shall be installed after the cables are in place.

L. Open wiring between individual equipment shall be neatly arranged, bundled, and tied approximately every 3 inches with nylon straps.

M. Cable installed in conduit, regardless of length, shall not exceed the maximum fill recommendations of the manufacturer and the requirements of the NEC and local codes. Where the aforementioned codes do not apply, the maximum fill shall not exceed 60 percent.

N. On all cable runs, 25 feet of slack cable shall be left coiled up in the ground as a service loop. Service loop shall also be provided on all cable terminated on terminal boards inside an enclosure.

3.02 SPLICES AND TERMINATIONS:

A. Wires and cables shall be continuous between signal locations; between signal equipment housing and the intended termination point at the wayside or station equipment, and between other termination points. Splices will not be permitted except as specifically approved by the Administration in writing. All terminations and splices shall be made in accordance with the cable manufacturer's recommendations. Termination hardware shall require Administration approval.

B. If splices and terminations are not made immediately after installation, ends of cable shall be sealed as recommended by the manufacturer to prevent entrance of moisture.

3.03 TESTING: Test all completed cable installation as specified in Section 17251.

PART 4: MEASUREMENT AND PAYMENT

4.01 SIGNALS –INTERIOR AND EXTERIOR WIRE AND CABLE:

D. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

TABLES I AND II ON THE FOLLOWING PAGE IS INCLUDED AS PART OF THIS SECTION.

Table I

PHYSICAL CHARACTERISTICS OF THE POLYETHYLENE OUTER JACKET

Physical requirements - Unaged	Guaranteed Values
Tensile strength, psi, minimum	1,400
Elongation at rupture, %, minimum	350
Physical requirements - Aged	
After Air Oven Test at 100 degrees C for 48 hours	
Tensile strength, % of unaged value, minimum	75
Elongation, % of unaged value, minimum	75
Heat Distortion	
After 1 hour in air oven at 90 degrees C, maximum	25
Absorption Coefficient	
Minimum	3,200
Environmental Stress Resistance	
After immersion in Igepal CO-630 at 50 deg C for 48 hours	No cracks

Table II
Insulation Thickness
Solid and Stranded Wires

Stranded Wires Rated 0-150V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/ Km	Ampacity
24	10	.254	43.6	1.107	2.3	3.43	1.5

22	10	.254	49.6	1.260	3.2	4.77	4.0
22(7/30)	10	.254	49.8	1.265	3.2	4.77	4.0
20	10	.254	57.8	1.468	4.8	7.15	6.5
18	10	.254	66.7	1.694	7.1	10.58	19.0
16	10	.254	73.0	1.854	8.8	13.11	24.0

Stranded Wires Rated 0-300V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/Km	Ampacity
24	12	.305	47.6	1.209	2.5	3.73	1.5
22	12	.305	53.6	1.361	3.5	5.22	4.0
22 (7/30)	12	.305	53.8	1.367	3.5	5.22	4.0
20	12	.305	61.8	1.57	5.1	7.6	6.5
18	12	.305	70.7	1.796	7.4	11.03	19.0
16	12	.305	77.0	1.956	9.1	13.56	24.0
14 (UNI)	12	.305	90.2	2.291	13.9	20.71	34.0
14 (CON)	12	.305	95.0	2.413	14.6	21.75	34.0

Stranded Wires Rated 0-600V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/Km	Ampacity
24	15	.381	53.6	1.361	2.8	4.17	1.5
22	15	.381	59.6	1.514	3.9	5.81	4.0
22 (7/30)	15	.381	59.8	1.514	3.9	5.81	4.0
20	15	.381	67.8	1.722	5.6	8.34	6.5
18	15	.381	76.7	1.948	7.9	11.32	19.0
16	15	.381	83	2.108	9.7	14.45	24.0
14 (UNI)	15	.381	96.2	2.443	14.6	21.75	34.0
14 (CON)	15	.381	101.0	2.565	15.3	22.8	34.0
12	15	.381	117.2	2.974	21.7	32.33	43.0
10	17	.432	144.0	3.658	33.7	50.21	55.0
9 (37/.019)	17	.432	163.0	4.14	47.1	70.18	-
9 (19x7/.01)	17	.432	182.0	4.623	47.5	70.78	-
8	17	.432	196.0	4.978	59.3	88.36	76.0
6	20	.508	243.0	6.172	93.4	139.66	96.0
4	24	.610	305.0	7.747	146.0	217.54	143.0
2	26	.660	383.0	9.728	226.0	336.74	160.0
1	28	.711	416.0	10.566	271.0	403.79	186.0
1/0	30	.762	478.0	12.141	358.0	533.42	215.0
2/0	39	.991	542.0	13.767	457.0	680.93	251.0
3/0	50	1.27	631.0	16.027	598.0	891.01	288.0
4/0	50	1.27	698.0	17.729	737.0	1098.12	332.0
500 kcmil	50	1.27	1088.0	27.635	1770.0	2637.28	580.0

Stranded Wires Rated 0-1000V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/ Km	Ampacity
18	18	.457	82.7	2.101	8.5	12.67	19
16	18	.457	89.0	2.261	10.3	15.35	24
14 (UNI)	18	.457	102.2	2.596	15.3	22.8	34
14 (CON)	18	.457	107.0	2.718	16.0	23.84	34
12	18	.457	123.2	3.129	22.5	33.53	43
10	20	.508	150.0	3.810	34.7	51.70	55
9 (37/.019)	20	.508	169.0	4.293	48.3	71.97	-
9 (19x7/.01)	20	.508	188.0	4.775	48.6	72.41	-
8	22	.559	206.0	5.232	61.5	91.63	76
6	22	.559	247.0	6.274	93.7	139.61	96
4	24	.610	305.0	7.747	146.0	217.54	143
2	26	.660	383.0	9.728	226.0	336.74	160
1	28	.711	416.0	10.566	271.0	403.79	186
1/0	30	.762	478.0	12.141	358.0	533.42	215
2/0	39	.991	542.0	13.767	457.0	676.46	251
3/0	50	1.27	631.0	16.027	598.0	891.01	288
4/0	50	1.27	698.0	17.729	737.0	1098.12	332
500 kcmil	50	1.27	1088.0	27.635	1770.0	2637.28	580

Stranded Wires Rated 0-2000V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/Km	Ampacity
16	20	.508	93.0	2.362	10.8	16.09	24
14 (UNI)	20	.508	106.2	2.698	15.8	23.54	34
14 (CON)	20	.508	110.0	2.794	16.6	24.73	34
12	20	.508	127.2	3.231	23.2	34.57	43
10	24	.610	158.0	4.013	36.2	53.94	55
9 (37/.019)	24	.610	177.0	4.496	50.0	74.50	-
9 (19x7/.01)	24	.610	196.0	4.978	50.5	75.25	-
8	24	.610	210.0	5.334	62.5	93.12	76
6	26	.660	255.0	6.477	96.1	143.19	96
4	26	.660	309.0	7.849	147.7	220.07	143
2	28	.711	387.0	9.831	227.7	339.27	160
1	28	.711	421.0	10.693	271.0	403.79	186
1/0	30	.762	478.0	12.141	358.0	533.42	215
2/0	39	.991	542.0	13.767	457.0	680.93	251
3/0	50	1.27	631.0	16.027	598.0	891.01	288
4/0	50	1.27	698.0	17.729	737.0	1098.12	332
500 kcmil	50	1.27	1088.0	27.635	1770.0	2637.28	580

Solid Conductor Wire Wrap Rated 0-300V

Conductor Size (AWG)	Nominal Insulation Thickness (mils)	(mm)	Nominal Wire OD (mils)	(mm)	Nominal Weight (lbs/M ft)	Kg/Km	Ampacity*
30	6	.152	22.3	.566	.54	.80	-
28	6	.152	25.0	.635	.76	1.13	-
26	6	.152	28.4	.721	1.1	2.09	-
24	6	.152	32.7	.831	1.6	2.38	-
22	6	.152	37.8	.960	2.4	3.58	-
20	6	.152	44.9	1.141	3.7	5.51	-

* Ampacity rating not available for these low amperage circuits.

END OF SECTION

SECTION 17251

TESTS AND INSPECTION

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for tests and inspections to be performed at points of assembly and on the job site. It is intended to provide minimum requirements for testing. Contractor shall organize a test program that verifies the adequacy of the system to meet all technical and performance requirements in an orderly and logical sequence.

B. Tests and inspections shall be for the purpose of verifying design and nameplate ratings; ensuring proper performance and safety to demonstrate compliance with these Specifications.

C. All installations shall be inspected before system testing for compliance with the functional and technical requirements specified herein and Administration approved installation drawings. After inspection, the Contractor shall physically and functionally test each item to be delivered under the Contract. All inspection and testing instructions shall provide for reporting non-conformance or questionable conditions to Administration. The Contract shall permit Administration and its designated representatives to participate in all inspections and witnessing of all tests, both in manufacturers' plants and at the construction site.

D. Test procedures and inspections shall be conducted according to the manufacturers' standards except as otherwise specified.

E. Conduct all tests in accordance with the approved test procedures. Except as otherwise specified, furnish all labor and materials necessary to perform tests, record data, and prepare reports. Tests shall demonstrate compliance with the requirements of these Specifications. Any changes required to bring the system into compliance shall be at no additional cost to the Administration, including the costs for additional testing. After completion of each test, remove all test equipment and temporary facilities, and restore the system to full operational status.

F. All tests which affect normal operations shall be done in accordance with INTERFACE REQUIREMENTS.

G. Contractor shall except as otherwise specified, furnish all labor and materials necessary to perform tests, record data, and prepare reports. Any changes required to bring the system into compliance shall be at no

additional cost to the Administration, including the costs for additional testing. After completion of each test, remove all test equipment and temporary facilities, and restore the system to full operational status.

1.02 RELATED WORK IN OTHER SECTIONS:

01300 Submittals.
01450 Quality Assurance
17021 Safety and System Assurance.
17103 Interface Requirements.
17195 Microprocessor Interlocking System.
17171 Relays and Plugboards.

1.03 INTERFACES AND WORK BY OTHERS:

Vehicles and vehicle operators required for on-site vehicle-related tests will be provided by the Administration as specified in Section 17103 and as specified in this Section.

1.04 QUALITY ASSURANCE:

A. Incorporate all requirements of Section 01450 Quality Assurance in the Test Program Plan, Test Procedures and Test Reports.

B. Test equipment of the proper type, capacity, range and accuracy shall be supplied by the Contractor to perform the required tests and inspections.

C. The quality of materials, fabrication and finish of all components, and their compliance with these Specifications, shall be assured by factory tests and inspections which Contractor shall devise and perform.

D. Each component and unit of the system shall have an inspection performed at its point of manufacture and evidence of this inspection and acceptability shall be indicated on the item where practicable.

E. The Administration reserves the right to witness any or all tests and inspections and tests in the Contractor's plants or other manufacturing facilities. The Administration shall be advised a minimum of 2 weeks in advance of each factory test. When tests are to be conducted continuously as in a production-line routine, the Administration shall be advised 2 weeks prior to the start of such tests provide the duration in which such tests will be conducted.

F. Contractor shall devise, perform and document field installation inspections to ensure all equipment furnished in association with this contract is installed, connected and adjusted in compliance with these Specifications.

G. All approved system and subsystem tests to demonstrate the installation meets these Specifications and design requirements shall be completed prior to any operational testing of systems or subsystems.

H. Contractor shall devise, perform and document such field tests as are required to ensure that all systems, subsystems, and operating equipment, provided under this Contract, function in a safe and proper manner and as required by these Specification.

I. The Administration shall have the right to witness any or all field tests conducted. The Administration shall be notified in writing at least 48 hours prior to each field test. No part of the system shall be placed in service without an authorized representative of the Administration being present.

1.04 SUBMITTALS:

A. Unless otherwise specified, all submittals shall be in accordance with Sections 01300.

B. Test Program Plan (CDRL).

C. Signal System Staging and Installation Plan (CDRL).

D. Test procedures for approval at least 30 calendar days prior to implementation (CDRL). Except where tests are to be performed in full accordance with published standards, include block diagrams depicting the test set-up for each test method, test equipment to be used, procedures, and method for recording data.

E. Except where results are recorded on a test data plate affixed to the component or unit, submit certified test reports.

F. Records of all field tests, giving procedures used and results.

G. Reports of factory inspection procedures employed to ensure the quality of the product.

H. Submit test reports no later than five working days after completion of testing.

PART 2: PRODUCTS

2.01 TEST PROGRAM PLAN:

A. Develop a Test Program Plan for the Non-Vital Request and Indication System. The purpose of this plan is to ensure Contractor has considered all testing requirements as contained in all Sections of the Specifications, has made adequate provisions for testing in their overall program plans and schedules; and creates an early mutual understanding between the Contractor and Administration on the range, depth and other aspects of the testing to be conducted. Test Program Plan shall contain, as a minimum, the following data:

1. A flow diagram indicating the logical sequence of tests, starting with factory assembly tests and concluding with system demonstration tests.

2. A list of test procedures (by test procedure number) to be submitted, preliminary submittal schedule, a preliminary schedule of tests, and a brief description of each factory and field test.

3. An outline and format of the procedures and test data sheets for each type of test.

4. Requirements (if any) for Administration-furnished material, personnel or equipment.

5. Requirements and recommendations for witness by Administration personnel.

6. A description of Contractor's in-plant and field testing organizations.

7. Flow of Quality Assurance and field test data and its use within Contractor’s Systems Engineering and Quality Assurance functions.

2.02 TEST PROCEDURES:

A. Contractor shall submit all test procedures to the Administration for approval at least 60 days before the scheduled test. No test procedures will be approved by the Administration prior to approval of Contractor’s Inspection and Test Plan.

B. Test procedures shall include, as a minimum, the following information:

1. Objective and scope.

2. Test setup.

3. Test prerequisites.

4. Test equipment to be used.

5. Personnel required for the test.

6. Estimated duration of the test.

7. Pass/fail criteria.

8. Samples of data sheets.

C. Procedures shall include electromagnetic interference compatibility testing and integrated system testing.

D. No material or test equipment will be furnished by the Administration for any testing or inspection.

E. Contractor's existing test and inspection procedures may be utilized upon Administration's approval.

2.03 INSPECTION AND TEST REPORTS:

A. Contractor shall submit to the Administration signed inspection and/or test reports for every inspection and/or test performed no later than 10 days after completion.

B. Test reports shall contain, as a minimum, the following information:

1. All data obtained during tests.

2. Analysis of the data.

3. Conclusions relating to the pass/fail criteria outlined in the test procedure.

4. Discrepancies found and corrective action taken.

5. Date of test.

6. Signature of person conducting the test.

7. Space for signature of witness.

8. Specific test equipment used by name, type, serial number, and calibration details.

9. Tested equipment item by serial number.

10. Remedial action necessary to pass tests, retest criteria, and retest results. Test equipment of the same model and, if possible, the same unit shall be used during retesting to ensure consistency. Changes made by Contractor in order to pass tests shall be at no additional cost to the Administration.

C. Inspection reports shall contain, as a minimum, the following information:

1. Complete description of facilities inspected.

2. Complete description of observations.

3. Discrepancies found and corrective action taken.

4. Suggested actions, including but not limited to leased facilities ready for disconnection.

5. Date of inspection.

6. Signature of person conducting inspection.

7. Space for signature of witness.

PART 3: EXECUTION

3.01 TESTS:

Conduct all tests as specified in this Section and in accordance with approved test plans and procedures. Except as otherwise specified, furnish all labor and materials necessary to perform tests, record data, and prepare reports. Tests shall demonstrate compliance with the requirements of these Specifications. Any changes required to bring the systems into compliance shall be at no additional cost to the Administration, including the costs for additional testing. After completion of test, remove all test equipment and temporary facilities and restore all systems to full operational status.

3.02 VEHICLES FOR TESTING:

The Administration will provide vehicles with crews to support the testing program. These must be scheduled 1 week in advance. Vehicles for testing will normally be scheduled 8 hours per day, 5 days per week, with the first hour of each day reserved for track inspection and setting up test limits, and the last 30 minutes reserved to return the operating crew to the yard.

3.03 CALIBRATION OF INSTRUMENTS:

A. All instruments or recorders employed in these test programs shall bear a record of calibration against certified standards by ANSI. Such calibrations shall be made at least every 180 days and at such other periods as may be directed by the Administration. Each test record shall identify the specific instrument employed in the test and the latest date of calibration.

B. The method and interval of calibration for each item shall be defined, based on type of equipment, stability, characteristics, required accuracy, intended use and other conditions affecting measurement control.

C. When test equipment is found to be out of calibration, the Administration shall conduct and document an evaluation of the validity of previous test results, to determine the acceptability of items previously tested. If determined the testing is invalid, a retest shall be conducted with properly certified test equipment and then resubmitted for approval. All additional re-testing shall be performed at Contractor's expense.

D. Out-of calibration tools or equipment shall be tagged and not used until they have been re-calibrated and verified.

E. Any tools or equipment found to be consistently out of calibration as determined by the Administration, shall be repaired or replaced by the Contractor.

F. A calibration shall be performed when inaccuracy is suspected.

G. All calibrations/certifications shall be recorded and become part of the quality assurance records.

3.04 SAFETY CERTIFICATION PROGRAM:

The Administration must certify the new Non-Vital Request and Indication System is operationally safe for employees, emergency service personnel and the public. To accomplish this task, the Administration will establish a Safety Review Committee (SRC) whose task will be to systematically review all test results and

supporting documentation against the approved design criteria. Upon approval of the documentation, the SRC will issue a "Certificate of Systems Safety" signifying the system is safe for service. Contractor will be required to take part in the Safety Certification Program along with signing the appropriate documentation as required by the Committee to substantiate system safety.

3.05 QUALIFICATION TESTING:

A. Contractor shall test engineering models or prototype units to verify that the equipment satisfies the design and environmental requirements of these Specifications.

B. Service proven equipment may not require these tests, but shall require that test results from in service performance in a similar operating environment or qualification tests, as described herein, previously performed for other transit properties be submitted for approval by the Administration.

C. New equipment or modified existing equipment shall require thorough qualification testing. Qualification testing shall consist of bench testing of operational systems or subsystems, and/or field-testing of same at the discretion of and as directed by the Administration. All expenses incurred during qualification testing, except for expenses incurred by the Administration, shall be borne by Contractor.

D. Environmental Test:

The test shall be such to assure proper operation over the temperature, humidity, and mechanical vibration and shock range as specified in these Specifications.

3.06 FIRST ARTICLE INSPECTION TEST (FAI):

A. Contractor shall perform a comprehensive FAI on the first interlocking, as well as any component or system that requires qualification testing.

B. FAI shall be required for service-proven equipment, if such equipment has been modified.

C. FAI shall include all interfaces to assure complete and proper operation of the equipment.

D. FAI shall require approval of the Administration before additional systems can be manufactured and installed.

3.07 FACTORY TESTS AND INSPECTIONS:

A. All systems, subsystems, and components shall be completely inspected and tested by the Contractor.

B. All components or units, may be tested on a sampling basis. An approved number of randomly selected components or units from the manufacturing process shall be tested to ensure the adequacy and acceptability of all components and units produced.

C. Each component and unit shall be inspected at its point of manufacture. Evidence of this inspection and acceptability shall be indicated on the item where practical. Otherwise, Contractor shall furnish test reports at the time of delivery.

D. Wiring Verification Test: A Wiring Verification Test shall be made in accordance with approved circuit plans. Wiring verification test shall include a count of wires at each termination, the assurance of continuity of each wire between terminations and the installation of the proper tags with correct circuit information. Both ends of each wire shall be checked during these tests to be certain their terminations are solidly applied and properly held in their correct place. These tests shall include verification of correct current where resistors are used to reduce current.

E. Operational Tests – Simulation:

1. Contractor shall factory test each CIHs concurrently with other CIHs cabled together to provide a complete subsystem.

2. Functions external to the CIHs and cases shall be simulated to assure proper interface to internal circuits, proper function of external apparatus and the proper indication response from the external apparatus. Simulated conditions of both normal operations and anticipated failures shall be imposed on the system to insure the system complies with all failsafe requirements.

3. Contractor shall include as part of the factory test a simulation panel which includes the following:

a. A faceplate showing the track layout for the section under test.

b. Toggle switches mounted on the panel which shall be connected to the equipment for the purpose of energizing or de-energizing each wheel detector circuit, including line circuits.

c. LEDs representing each pushbutton indication. The color and arrangement of these lamps shall conform to the pushbuttons they represent.

F. Documentation:

1. Results of all factory tests shall be recorded on the prescribed forms. An original copy of all test results shall be forwarded to the Administration at the conclusion of the tests.

2. Modifications to approved circuit plans required in order to successfully complete the factory tests shall be shown on plans supplied by the Contractor for field installation and cutover. These plans shall be submitted as hard copy and as the latest version of Microstation files.

3. All printed circuit cards, relays, and other components used during the factory test shall have their locations within the instrument house documented during the test. These components shall be reinstalled in the same location as they were during the factory test prior to commencement of field-testing.

4. All software and flash memory shall be identified and proper documentation and control provided as required in Section 17195.

5. Upon successful completion of the factory test for each CIH, as attested to by the Administration removal of all temporary circuits to facilitate testing, the CIH shall be padlocked and no further testing or work performed.

G. All ATP signal and HCWS locations shall be operationally tested and inspected as a complete functional assembly prior to shipment. Test each function by simulating operating conditions. Where equipment is related to a safety function, each component or subassembly shall be separately inspected and tested.

H. Perform factory tests and inspections as needed to verify the requirements of Section 17021.

3.08 FIELD TESTS AND INSPECTIONS:

A. General:

1. Contractor shall perform all tests required to insure the proper and safe operation of all signal equipment and prove the adequacy and

acceptability of the total installation. Testing shall be in accordance with applicable sections of the AREMA Signal Manual Part 2.4.1

2. Tests to be performed shall cause each system and subsystem to be sequenced through all required operations and include simulated conditions to prove the installation is in compliance with failsafe requirements.

3. Prior to operational testing, check the quality of the installation by visual inspection and by tests of continuity, insulation resistance, resistance of ground connections, vital circuit breakdown, and other tests as required.

4. The Administration shall receive written notification at least 48 hours prior to each test.

B. Cable Tests:

1. All wire and cable shall be tested after installation to insure continuity and proper connection according to the plans. Perform tests to ensure there are no conductor-to-conductor shorts.

2. Insulation Resistance Test:

a. Test all wire and cable installed at the job site for insulation resistance between the conductor and ground, using a direct resistance-reading instrument having a self-contained or self-generating test voltage of 500 to 1000VDC.

b. The minimum insulation resistance to ground for circuits operating below 600V shall be 50 megohms, for circuits operating at 600V and above, 100 megohms. Wires and cable shall be replaced when insulation resistance is below these values. Actual meter readings shall be recorded on test forms.

c. Prior to the test, disconnect power sources, running rail connections, direct connection to ground circuits, and any equipment that may be damaged by the voltages of the test instrument unless connection incorporates an isolation link.

d. The connection to ground for the test shall be the most convenient previously verified low resistance connection to ground available.

C. Circuit Breakdown Tests:

1. All wiring shall be tested after installation to ensure continuity and proper connection according to the circuit plans.

2. Where parallel circuits exist, test each parallel path independently to ensure the continuity of each path.

3. Each function shall be tested as a complete system or subsystem for the correct operation in response to circuit element or contact closure.

4. For vital microprocessor outputs, the outputs shall be simulated to be set to low, verified through a program analyzer, and the termination point of the wire verified that there is “zero” voltage.

5. The breakdown test shall verify all circuits are assembled and wired in accordance with approved circuit and shop drawings.

D. Equipment Location Verification:

Contractor shall verify all wayside equipment is located at the proper chaining, at the correct distance between equipment locations, and at the correct height per approved drawings.

E. Interlocking Operation Tests:

1. Test each interlocking function for correct performance and safety. Include simulated unusual conditions to determine all equipment will respond in a safe and desirable manner.

2. All interlocking routes shall be checked and route security proven. The approved route and aspect charts shall be proven.

3. Functions to be tested shall include but not limited to:

a. Indication locking:

1. Pushbutton indications.

2. Switch indications.

3. Switch correspondence.

c. Route locking.

d. Time locking.

e. Approach locking.

l. Pushbutton light out protection.

m. Manual and Automatic switch and route selection control.

n. Manual, Automatic and LRC mode control/indications.

o. Event recorder.

p. Train Stop Operations/Indication.

4. Microprocessor interlocking system shall be tested in accordance with manufacturer's recommendation.

F. Wheel Detector Circuits:

1. Test wheel detector circuits to ensure proper design, installation, and adjustment in accordance with manufacturers recommendations.

2. The wheel detector zone relay shall be de-energized when the entrance end or any of the exit ends of the zone are disconnected. The wheel detector zone relay shall also be de-energized when the entrance end or any of the exit ends of the zone are shorted.

3. Perform the following test separately with all types of rail vehicles that operate in the North Avenue Yard:

a. Begin with rail vehicles leading wheel 1 foot away from the rail connected wheel detector device at the entrance point of a wheel detector zone.
b. Have the vehicle slowly advance until it is directly over the first element of the device. The wheel detector zone relay should remain energized.

c. Have the vehicle slowly advance until it is directly over the second element of the device. The wheel detector zone relay should remain energized.

d. Have the vehicle slowly advance until it leaves the trailing edge of the second element of the device. The wheel detector zone relay should de-energize.

e. Have the vehicle traverse the route until its trailing wheel leaves the trailing edge of the second element at the exit point of the route. The wheel detector zone relay should energize.

f. Repeat this test for each of the available entrance and exit points of each of the wheel detector zones and record results.

G. Wayside Pushbutton Tests: After installation, test each wayside pushbutton in accordance with the approved test procedure. Verify the wiring and pushbutton control and indications function as intended. Perform and record the following tests:

1. Breakdown of indication and control circuits.

2. Verification the pushbutton actuator requests the proper route selection circuits.

3. Verification the pushbutton actuator cancels the proper route selection circuits.

4. Verification the pushbutton indications illuminate as intended.

3.09 SYSTEM INTEGRATION TESTS:

A. After Contractor has completed installation testing and verified system operation, the following tests, which are not part of the Integrated Service Testing support, shall be performed, at a minimum, utilizing passenger vehicles and any other Administration system elements as necessary.

B. Interlocking Tests shall be performed to verify system safety through dynamic operation of LRVs. Tests shall thoroughly exercise both automatic and manual route clearing, normal and reverse moves, switch machine hand and motor mode of operation and pushbutton-initiated routing. Test all interlocking movements to demonstrate all aspects of safe operation in the yard system environment.

C. System Interface Tests: Contractor shall test all interfaces between the existing wayside signal systems, the new Route Request System, the HCWS and all other work performed under this Contract to verify there are no adverse effects on safety or proper operation of the entire system.

3.10 SYSTEM DEMONSTRATION TESTS:

A. Signal System Demonstration Tests shall demonstrate the signal system is fully operational under normal and abnormal conditions according to the operating criteria provided. These tests are not part of the Integrated Service Testing support.

B. A system operational test shall be performed in which all functions of the complete signal system shall be exercised. Functions shall include, at a minimum, the following:

1. Detection of all rail vehicles on yard tracks.

2. Elimination of conflict arising from 2 vehicles simultaneously requesting conflicting routes through a particular interlocking.

3. Determine all wayside hardware will be safe for the vehicle prior to permitting any route to be traversed.

4. Routing with pushbuttons, MTSP, and existing switch pushbuttons for all routes at terminals.

5. Routing from LRC at 94 interlocking for all available routes.

C. Perform and record testing required to demonstrate compliance with electromagnetic compatibility criteria as specified in Section 17117.

D. Perform and record tests and inspections as required to verify the requirements of Section 17021.

3.11 30 DAY OPERATIONAL TEST:

A. After Administration approval of all field acceptance tests, the system shall be placed into revenue service and shall immediately start a 30 day Operational Test (30DOT). During this time, all equipment and components shall perform in accordance with all required system and equipment requirements under actual operational and environmental conditions for a period of 30 consecutive calendar days. In the event of errors or system malfunctions, including but not limited to equipment failure or failure to comply with any specified requirement or the approved final design, the Contractor shall make the necessary corrections as they occur, at no additional cost to the Administration. The test shall then restart and

continue until the objective of thirty consecutive calendar days of error free operation has been achieved.

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT:

A. Testing and Inspections except as noted below will be measured on a lump sum basis including all test plans, test procedures and test reports.

B. Factory testing of individual components and materials by the original manufacturers will not be measured.

4.02 PAYMENT:

A. Testing and Inspections will be paid for at the contract lump sum price including all associated test plans, procedures and reports except as noted below.

B. Costs for factory testing of individual components and materials by the original manufacturers will be considered integral with the costs of the components or materials to which it applies..

END OF SECTION

SECTION 17263

TAGS, LOCKS, AND KEYS

PART l: GENERAL

1.01 DESCRIPTION: This Section includes specifications to furnish and install tags, locks, and keys.

1.02 RELATED WORK IN OTHER SECTIONS:

01300 SP – Submittal Procedures.

1.03 QUALITY ASSURANCE:

A. Contractor shall check during factory test that all tags, labels, stamping and /or stenciling specified herein are present, correct and properly applied.

B. Tags and labels shall be as approved by the Administration and of the same type submitted for approval.

C. Contractor shall, during routine field inspection, check to see that all field installed labels are present, correct and properly applied. Work will not be considered complete until all tags and markings are correct and in place.

1.04 SUBMITTALS: Unless otherwise specified, all submittals shall be in accordance with Section 01300.

A. Submit manufacturer's product literature and specifications for each type tag (CDRL).

B. Submit shop drawings for each type of tag (CDRL).

C. Submit samples of each type of tag (CDRL).

PART 2: PRODUCTS

2.01 TAGS:

A. Stencils: White enamel paint.

B. Flat Tags:

1. Laminated phenolic or vinyl plastic, white with black lettering.

2. Minimum 2 holes for screw mounting.

3. Minimum thickness: 0.050 inch.

C. Wire Tags:

1. White vinyl plastic with black lettering, protected by a clear 0.005 inch over-laminate.

2. Minimum 0.020 inch thick.

3. All corners rounded to approximately 0.125 inch radius.

4. Lettering minimum 0.125 inch high with minimum 0.09375 inch spacing between lines.

D. Cable tags: Same as wire tags, except attached to the cable with pre-tied nylon cord loops.

E. Sleeve tags:

1. White vinyl plastic with black lettering.

2. 0.125 inch lettering.

3. Length as required, minimum length is 0.75 inch.

4. Diameter shall be selected for a snug fit on wire.

2.02 LOCKS AND KEYS:

A. Padlocks:

1. Identical to the current Administration's interchangeable core padlock #21B772 manufactured by Best Access Systems.

2. All locks shall have identically keyed cores for contractor use.

3. The contractor will provide the authority with replacement Administration's padlock cores, identical to #1C7E1-626 manufactured by Best Access Systems.

B. Keys:

1. Identical to the existing CLRL signal padlock keys manufactured by Best Access Systems.

2. Two keys with each lock furnished.

C. Keying Arrangement:

1. Keying arrangement shall be the same as existing current CLRL equipment.

PART 3: EXECUTION

3.01 TAGGING:

A. Provide and install a unique equipment identification code for each type of fixed equipment and replaceable element. The identification code shall be similar to that on existing CLRL.

B. Stencil:

1. Field cases and junction boxes using 1.5 inch lettering to identify location.

2. Relay and equipment racks and cabinets, using 0.75 inch lettering to identify racks and cabinets.

C. Install flat tags on:

1. Relay plug-boards to show relay designation.

2. Equipment to show equipment designation.

3. Main Terminal Board to identify cables.

4.

D. Install phenolic tags on:

5. Route pushbutton enclosures.

a. Above pushbuttons, indication LEDs.

E. Cables:

1. All cables, including single conductor cables, shall be assigned a discrete cable identification number, to be applied to both ends of each cable by permanent nylon cord loop and showing the cable name in black characters. This identification shall also be shown

on cable, circuit, and wiring diagrams. Each conductor in each incoming cable shall be tagged with proper nomenclature.

2. Install cable tags, showing cable identification, with pre-tied nylon cord loops on the cable sheath near the pothead.

F. Wires:

1. All wires shall be tagged at each termination point with a waterproof sleeve-type tag. Each terminal board terminal shall also be tagged with a waterproof flat-type tag securely fastened to the front of the board.

2. Lettering on all tags shall be typed, waterproofed and permatized.

3. Wire tags shall bear the following information in the sequence listed:

   a. Wire nomenclature.

   b. Cable designation (if applicable).

   c. Near end termination point (rack number, row and contact number, if applicable).

   d. Far end termination point (rack number, row, and contact number, if applicable).

4. Install wire tags:

   a. At the terminal end of all wires and cable conductors.

   b. Adjacent to terminals or binding posts, where possible.

   c. Tags shall not slide off the wire when wire is disconnected from its termination point.

5. Install sleeve tags on all wires connected to plug-board contacts. Tags shall meet the requirement of Article 3.01.E above.

3.02 PADLOCKS: Install padlocks on:

A. Wayside cases and junction boxes.

B. Wayside Pushbuttons

PART 4: MEASUREMENT AND PAYMENT

4.01 TAGS, LOCKS AND KEYS:

A. No separate measurement shall be made for the work required under this Section.

B. No separate payment shall be made for the work required under this Section. All cost in connection therewith will be considered included in the bid items requiring their use.

END OF SECTION

SECTION 17402

GENERAL DESIGN REQUIREMENTS

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section includes specifications for the general design requirements applicable to all portions of the work unless otherwise specified.

1.02 GENERAL DESIGN REQUIREMENTS:

A. Specifications provided in the IFB define a minimum baseline design based on a minimum set of functional requirements; however the complete set of requirements will be completed during the design phase by the Contractor.

B. This contract seeks the provision of the subsystems/systems under its scope by using modern, open and modular components. The design presented by the Contractor shall be based on modern, open and modular component design, and not based on any vendor specific proprietary software.

C. The system design process shall consist of at least two review iterations; one preliminary and one final.

D. All software components of the system shall be modular and it shall be possible to model them according to the 7-layer OSI Model for data exchange. A Server /client architecture for these systems is preferred.

1.03 HARDWARE DESIGN CRITERIA:

A. Modular Design:

1. Use modular design throughout. Organize electrical and mechanical components in rack-mounted plug-in assemblies.

2. Minimize the mixing of equipment associated with two subsystems in one plug-in assembly.

3. Equipment serving similar functions should be in the same relative location on all racks where practical.

4. Printed circuit cards designed to perform the same function should be interchangeable regardless of whether these cards are of the same or different subsystems. All printed circuit cards should be properly identified to prevent improper insertion or operation.

B. Layout:

1. Equipment Arrangement: To the extent possible, two or more points of adjustment, which are required during the same operation, should be located in such a way that they can be operated by one person.

2. Wiring:

a. Where a full hand grasp is required to connect or disconnect a connector or fastener, a minimum of two inches of clear space around the connector or fastener should be provided. Clear space should be provided around connectors and fasteners that can be connected or disconnected with thumb and fingertips.

b. All wiring shall be supported near terminal points, and shall be terminated with appropriate hardware.

c. The mechanical strength of each connector shall be at least 85 percent of the mechanical strength of the wire. The electrical conductivity of each connector shall be at least 95 percent of the electrical conductivity of the wire.

d. A minimum of 20 percent spare terminals and spare wire per multi-conductor cable (minimum 4 wires) shall be provided on each terminal block for all wiring. Terminals used for the termination of spare wires shall be considered spare terminals. The Engineer must approve exceptions to this requirement.

e. Panel connections shall be plug or connector ended within the console to facilitate removal for maintenance as approved by the Engineer.

C. Test points:

1. Test points for routine adjustments, checking essential voltages and waveforms, and for injecting test signals should be provided where required for troubleshooting and routine maintenance.

2. Selected test points should be provided to detect defective printed circuit cards and equipment modules without the disconnection of wires.

D. Adjustments:

1. Adjustable components should be avoided wherever possible by

the use of appropriate circuitry, stable components, and high-tolerance circuits.

2. All parts that require periodic service or maintenance and all tunable circuit adjustments should be easily accessible.

3. Adjustable components not intended for adjustment by operation personnel should have locking devices or should be self-locking to prevent inadvertent operation or drift. Special precautions including limitation of adjustment range must be established for vital calibrations.

4. Interacting adjustments should be avoided, whenever practical.

5. Where possible, the replacement of components or printed circuit cards with spares should not require compensating adjustments to other components or modules.

6. When built-in indicators or meters are associated with adjustment, the adjustment point should be sufficiently close to the associated indicator so that both may be manipulated and observed by one person.

7. All lamp indicators shall utilize LEDs.

E. Environmental Parameters: Except as otherwise specifically provided in other section all systems and equipment shall perform properly without damage under the following conditions.

1. CIHs:

a. Ambient Temperature Range: 10 to 35 degrees C.

b. Relative Humidity Range: 50 to 90 percent (non-condensed).

2. Trackside:

a. Ambient Temperature Range: Minus 20 to 50 degrees Centigrade. Outdoor equipment shall also withstand the effects of solar radiation.

b. Relative Humidity Range 30 to 95 percent. Outdoor equipment will be subject to condensation.

1.04 QUALITY ASSURANCE:

A. Work for this section shall follow quality assurance plan requirements,

applicable codes and standards, and industries best practices as specified elsewhere.

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 as specified elsewhere.

1.05 GUIDANCE TO CONTRACTOR:

A. Any equipment meeting the requirements of this specification may be considered for use. The specific models of equipment and accessories to be submitted under this specification must be approved by the Engineer, based on their degree of compliance with these requirements and their suitability for the needs of the Administration.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

SECTION 17403

PROJECT MANAGEMENT AND ENGINEERING SERVICES

PART 1: GENERAL

1.01 DESCRIPTION:

A. This Section specifies requirements for the Contractor's Project Management and Engineering Services, which includes planning and design of the work to be performed under this contract.

1.02 PROJECT MANAGEMENT AND ENGINEERING SERVICES:

A. Contractor shall provide project management and engineering services throughout the entire period of performance of the contract including, but not limited to:

1. Project Control Functions including Program-Schedule Network Analysis.

2. Project organization including functions and levels of responsibility for all Contractor's personnel including subcontractors assigned to project design, production, QA/QC, installation, and testing activities.

3. Quality Assurance/Quality Control Program as specified elsewhere.

4. Communications and document control procedures for originating, transmitting, filing, and retrieving all project documentation, including:

a. Timely flow of needed information to team members and to other Administration contractors where work of this Contract interfaces with theirs.

b. Tracking and documenting information exchanges within the team, including telephone conversations.

c. Effective project filing system for rapid retrieval of all correspondence, records, and other pertinent data.

B. Project safety, health and substance-abuse program administration in accordance with Section 01360.

C. Progress meetings: Specified elsewhere in these specifications.

1.03 SYSTEM DESIGN MANAGEMENT:

A. Specified elsewhere, and related attachments, the Contractor shall conduct two major technical project review presentations in addition to the monthly design review meetings. Executive Level Presentation to be provided upon the contract award no later than two weeks after the NTP, Preliminary Design Review (PDR) submittal to be provided no later than 1 month after the NTP, and the Final Design Review (FDR) submittal to be provided no later than 3 months after the NTP. PDR and FDR presentations and review meetings shall be shall be conducted no more than ten working days after completion of the submittals unless otherwise specified. The presentation for PDR and FDR and discussion will be conducted in a location specified by the Administration.

B. For the preliminary design review presentation, the Contractor shall present the design approach including the following: overall space layout and design, total system functional description, software system overview and preliminary design, computer architecture and overall computer system configuration.

C. For the final design review presentation, the Contractor shall include in his presentation all design documentation required for the project. Approval of the FDR and associated documentation will allow the coding effort and other final designs to be formalized and completed. Any work efforts (other than design) before the approval of the FDR will be at the Contractor' own risk. In this presentation the Contractor shall present and review the preliminary Migration Plan.

D. The Contractor may procure hardware after individual products are approved.

E. After the design phase is over a Factory Acceptance Testing (FAT) shall take place. Under the factory acceptance period the Contractor shall test the entire system in the Contractor’s designated facilities as specified by the subsystems respective sections in this contract. The FAT shall include at least one unit of each type of field device.

F. The Contractor may begin physical construction after the applicable design drawings are approved. The Contractor shall coordinate and obtain approval form Engineer prior to starting any work.

G. Deployment of hardware may occur only after completing the FDR.

H. Unless otherwise specified, Systems acceptance testing shall be perform to every device and subsystem prior to commissioning, integration with another subsystem or cut-over.

I. Once all cut-overs have been finalized and the overall system is fully

integrated, a 30 day acceptance test shall be performed per the specification contained in other sections, those approved under the design phase and those recommended by the contractor.

J. Final Acceptance Testing shall be performed to all subsystem prior of contract close-out to verify that all devices, subsystems and the system have been delivered and are working according to the specifications. All open discrepancies shall be resolved and closed on this phase.

PART 2: PRODUCTS

NOT USED

PART 3: EXECUTION

NOT USED

PART 4: MEASUREMENT AND PAYMENT

4.01 MEASUREMENT AND PAYMENT:

A. The work required under this Section will not be measured for payment.

B. All cost in connection with the work performed under this Section will not be paid directly but will be considered incidental to the items of work provided under Payment Schedule per Specification Section 01110.

END OF SECTION

APPENDIX A

LIST OF CONTRACT DRAWINGS

APPENDIX A - LIST OF CONTRACT DRAWINGS

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APPENDIX B

WORK BLOCKS/RED TAGS FOR CONTRACTORS

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B-2 MTA MEMORANDUM – Light Rail Work Block/Red tag Request Meeting

B-3 MTA LIGHT RAIL WORKBLOCK/RED TAG REQUEST FORM

MTA Maryland	MTA CENTRAL LIGHT RAIL LINE STANDARD OPERATING PROCEDURE		
Procedure No. LR.GP.00.08.00	**Procedure Name:** Work Block / Red Tags for Contractors		
Rev No. 1	**Issue Date:** 08/24/04 **Review Date:** 02/26/09	**Supersedes Procedure/Bulletin No.** LR.00.08.04.02.00	Page 1 of 6

I. Subject:

Standard Operating Procedure for Contractors Working On the Baltimore Central Light Rail Line

II. Purpose :

Periodically, contractors will need to work on or around the Central Light Rail Line for the purpose of maintenance, modification, repair, and construction. The purpose of this procedure to ensure that all contractor personnel working on or around the Central Light Rail Line's main line tracks, catenary, or right-of-way, are conversant with MTA operating rules and Rail Road Worker Protection (RWP) safety rules, policies, procedures, regarding WORK Blocks/Red Tags. The following guidelines are meant to ensure that these work areas are protected.

III. Responsibilities:

A. It is the responsibility of any contractor working on, fouling, or having the potential to foul the CLRL to have the proper authorization, to do so. In addition to adhering to all MTA's Operating and RWP safety rules, policies, and procedures.

B. It is the responsibility of any contractor working on, fouling, or having the potential to foul the CLRL to attend RWP training before working on or near the CLRL.

C. It is the responsibility of the Light Rail Work Block / Red Tag Coordinator to review and authorize or not authorize all Work Block / Red Tag request forms submitted by contractors working on the CLRL. It is also this individual's responsibility to advise contractors of approved Work Blocks / Red Tags, maintain, update, and disseminate the General Order.

D. It is the responsibility of all Light Rail management personnel to ensure that contractors working on the Central Light Rail Line are in compliance with this procedure.

Prepared By:

Michael Wiedecker — Michael Wiedecker — 9-14-09
(Print Name) (Signature) (Date)

Reviewed by: **Superintendent, Light Rail Operations**

Ken Rogers 9/16/2009

Deputy Director of Light Rail Operations

Gary Hinton — 9/14/09
(Print Name) (Signature) (Date)

Reviewed by Office of Safety, Quality Assurance and Risk Management:

Stanley Snead — Stanley Snead — 9/16/09
(Print Name) (Signature) (Date)

Approved by Director of Light Rail Operation

Fletcher Hamilton — 9/14/09
(Print Name) (Signature) (Date)

IV. Definitions:

A. Fouling A Track
The placement of an individual or equipment in such proximity to a track that the individual or equipment could be struck by a moving train or on-track equipment. In any case within 7.5 feet from the outside edge of the rail (10 feet of the center line of track).

B. General Order
Order issued by authority of the Superintendent of Transportation, which contains changes in rules, speed restrictions and list any work block or red tag activities.

C. On Site Coordinator (OSC)
A trained and qualified employee that communicates with LRC, designates the working limits, the type of On-Track Safety to be used, the assigning and positioning of Flagmen or Watchmen. The OSC also conducts the job briefing before any railroad worker fouls a track.

D. On-Track Safety
A state of freedom from the danger of being struck by a moving train or other rail mounted equipment, provided by operating rules and RWP Safety rules that govern track occupancy by personnel, trains and on track equipment.

E. Red Tag
The written authorization designed to convey rights to de-energize catenary power or signal power between specified points and for a specified period of time. A Red Tag is issued where the removal of Catenary Power/Signal Power is required. This includes any work under, around, or within 10' feet of the Catenary System. With the exception of certain conditions, which are subject to MTA approval, Red Tags may only be performed during periods of non-revenue service.

F. Restricted Speed
Prepared to stop within half the range of vision, short of vehicle, obstruction, or switch improperly aligned, looking out for broken rail, but not exceeding twenty (20) miles per hour outside of interlocking limits, and (15) mile per hour within interlocking limits. Speed applies to entire movement.

G. Work Block
A segment of track that is being fouled, for maintenance or repair.

H. Work Block Authorization
The written authorization designed to convey rights to obstruct or use a designated section track between specified points and for specified period of time without the removal of catenary power or signal power.

I. Working Limits
A segment of track with definite boundaries established in accordance with the rules upon which trains and locomotives may move only as authorized by the railroad worker having control (OSC) over that defined segment of track. Working limits may be established through Exclusive Track Occupancy (ETO), Inaccessible Track (IT), Foul Time (FT) or Train Coordination (TC) as defined in the MTA Light Rail RWP Manual.

V. Procedure:

A. General

1. The Light Rail Control Center (LRC) monitors and controls the operation of the Entire CLRL. LRC is in direct communication, via radio, with all Light Rail Vehicle Operators. LRC is also in direct Communication, via radio or a working Cell Phone, with all On Site Coordinators. All parties working within the fouling space or working with the potential to foul the tracks do so under strict control of LRC and are to obey all orders generated by LRC.

   a. The Central Light Rail Line's hours of operation are:
      - Mainline: Monday – Saturday…3:59 am until 1:20 am Sunday…..9:39 am until 9:35 pm
      - Cromwell Yard: Monday thru Friday 6PM until 6AM, weekends, operations cease at 1AM on Saturday and recommence at 8AM on Sunday.
      - Contractors requesting Work Block / Red Tags must submit all requests to the Light Rail Work Block / Red Tag Coordinator based on these hours.

   b. There will be occasions when the hours of operations may be extended due to Special events, or weather conditions. In case of both normal and extended service, Work Block / Red Tags previously granted may be canceled or delayed at the sole discretion of the Light Rail Operations.

   c. Prior to any work on the MTA's Central Light Rail Line, Contractor personnel must complete and pass the MTA's Railroad Worker Protection Training Course. This course is provided at no cost to the contractor.

   d. Any section of track removed from service for maintenance, modification, repair, Construction, or recovery activities will incorporate a Work Block to the nearest Fixed Signal or Chain Marker.

   e. All Work Block / Red Tags will have one qualified individual designated as the On Site Coordinator (OSC). The OSC will have all the responsibilities as defined in the RWP Manual.

f. All train movement through Work Blocks will be done at Restricted Speed.

g. Possession of a valid Red Tad Tag for power outage does not in itself establish working limits or On-Track Safety. Movement of non-revenue vehicles should be expected. All activities will be monitored and controlled by LRC.

2. All requests to work on or foul the CLRL property, including main line tracks, right-of-ways, and the Catenary System must be submitted on a Work Block / Red Tag Request form (refer to form #1). Requests submitted less than one (1) week in advance are subject to rejection. The submittal of a request does not constitute its approval.

3. All approved Work Block / Red Tags will be included in the General Order (refer to form #2), which is distributed to each department at the North Avenue facility and the Cromwell facility (Operations, Systems, Maintenance, Catenary, Maintenance of Way, and Rail Car Maintenance). Contractor notification is communicated by the Light Rail Work Block / Red Tag Coordinator.

4. Contractors requesting Red Tag Power Outages must be aware that a Red Tag Authorization form (LRTP-1) will be generated (refer to form #3). The LRTP-1 is a 3-page document (white, yellow, and pink). Once completed, the white copy is held in LRC, the yellow copy is held by the Maintenance Department, and pink copy is distributed as follows:

   a. Once the Red Tag has been fully implemented by MTA personnel, the yellow and pink copy will be delivered to the On Site Coordinator (OSC) at the location specified on the LRTP-1 from (Deliver Red Tag to Location). It serves as a guarantee to the contractor that power has been removed from the effected area, and all safety devices, including ground straps and grade crossing cutouts have been installed, as required.

   b. The On Site Coordinator (OSC) must sign the LRTP-1 on the "Accepted By" line and clearly print their work phone number and their home phone number.

   c. The MTA personnel will then separate the yellow and pink copies and give the pink copy to the OSC. MTA personnel will maintain possession of the yellow copy and the OSC must maintain possession of the pink copy.

   d. It is imperative that the OSC be on location for the entire duration of the work period.

   e. The OSC is responsible for the timely return of the pink copy as specified on the LRTP-1 form (Red Tag Ending Date & Time).

   f. On or near the scheduled termination time of the Red Tag, MTA Maintenance personnel will return to the work site and contact the OSC to retrieve the LRTP-1.

g. When the OSC returns the pink copy he/she must ensure that the work is complete and all personnel and equipment are not fouling the CLRL or the Catenary wire. This is a guarantee, upon its return to MTA personnel, that all contractor personnel and equipment have cleared the main line track areas.

h. It must be absolutely understood that Power restoration cannot be performed until the pink copy of the LRTP-1 is returned to MTA personnel.

i. It is further understood for operational purposes, MTA may require an early stoppage of work and the termination of the Red Tag.

j. If the work is completed earlier than anticipated, the OSC must contact LRC for further instructions.

5. In addition to the Work Block / Red Tag request form, contractors may be required to submit:

a. A Work Plan or Time Line (refer to form #4) for review by the MTA. This document should detail the length of time required, exact nature of the work, and any equipment to be used during the work.

b. A detailed set of drawings and / or plans showing the exact nature and location of any excavations, etc. Prior to the start of any excavation on the MTA's right-of-way, it must be determined by the contractor if any cable or other equipment is buried in the area, and to submit detailed plans as to their methods of excavation.

c. A detailed list of emergency contact telephone numbers for the appropriate contractor personnel.

d. A manpower and equipment request form, including a Test Procedure (refer to Form #5), for review and approval by the MTA.

B. Establishment of On-Track Safety:

1. Before any work begins, RWP track safety must be established. All RWP On-Track Safety must be established in accordance with the MTA Light Rail RWP Manual.

2. Prior to starting work under an approved Work Block request, the On Sight Coordinator must contact LRC and request permission to begin work.

a. Obtain permission from Light Rail Control to begin work by performing the following:

Call LRC via radio or cell phone (410 454-7590) and give your:

1) Name and company name and the number of the employees working with you.

2) That you are requesting permission to enter the mainline.

3) The type of RWP On-Track Safety you will be using.

4) Your working limits by chain marker or station.

5) Description of the work you will be performing.

3. LRC will advise the contractor to stand-by until all trains operating in the effected area have been contacted and advised of the location and nature of the work.
4. On receipt and confirmation of the information by each operator, the contractor will be provided with the current time, reminded of the movement of trains in both directions, and instructed to notify LRC when their work is completed and all personnel in their work crew is clear of the main line track area.
5. The OSC must conduct a Job Briefing before anyone fouls the tracks.
6. The OSC must be in possession of a MTA provided radio or a working cell phone.
7. Once On-Track Safety has been established, the work crew must work only within the authorized limits of the On-Track Safety.
8. Failure to do so will result in the immediate stoppage of work, and ejection from MTA's property.

C. High-Rail Equipment

1. If the contractor's work requires the use of High-Rail Equipment, MTA's maintenance Personnel must serve as the pilot. They will observe and supervise the mounting and dismounting of the High-Rail Equipment onto the main line tracks, and control required switch movement, while in direct communication with LRC.

VI. Attachments and Forms:

1. Work Block / Red Tag Request Form (form # 1)
2. General Order (form #2)
3. Red Tag Outage Form…LRTP-1 (form # 3)
4. Contractor's Work Plan / Time Line Form (form #4)
5. Request for MTA Manpower and Equipment Form (form #5)

VII. Distribution:

Light Rail Control, Light Rail Supervision, Light Rail Maintenance, Light Rail Operators, Light Rail Transportation, Office of Safety Quality Assurance and Risk Management, Transit Police, Office of Training and Development.

WORKBLOCK / RED TAG REQUEST FORM

COMPANY:_____ **NAME:**_____

OFFICE PHONE:_____ **HOME PHONE:**_____

WORK SCHEDULED:_____

LOCATION OF WORK:_____

WILL WORK INVOLVE USE OF HI-RAIL VEHICLE: YES NO

STARTING WORK DATE: _____ **TIME:**_____

ENDING WORK DATE: _____ **TIME:**_____

Be aware that actual WORKBLOCK & RED TAG start and ending times may vary according to the revenue service schedule. Contact the Light Rail Control Supervisor on duty (410) 454-7590 or 91, 92, for confirmation of WORKBLOCK & RED TAG scheduling times.

WORK CREW ON SITE COORDINATOR:_____

RADIO CALL ID: _____ *(If previously assigned)*

PAGER: _____ **CELL PHONE:**_____

WORK CREW IS REQUIRED TO CONTACT LIGHTRAIL CONTROL TO REQUEST AUTHORITY TO ENTER MAINLINE. COMMUNICATION MUST ALSO BE MAINTAINED THROUGHOUT THE WORKBLOCK DURATION, AND UPON COMPLETION OF ALL WORK, THE WORKPARTY MUST REPORT CLEAR OF MAINLINE TRACK AREA. **ALL MEMBERS OF THE WORK CREW MUST HAVE VALID RWP ID AND THE ID'S MUST BE VERIFIED BY THE OSC DURING THE JOB BREIFING**.
WORK CREW ON SITE COORDINATOR SIGNATURE:_____

RED TAG REQUIRED: YES NO

MTA should deliver RED TAG to work crew at: _____
(specify location: Chain marker or station, etc)

GROUNDING STRAPS: Contractor to provide _____ MTA requested to provide _____

SPECIAL NOTES: *(grade crossing cut-outs, escorts, test trains, etc.)*

What type(s) of On-Track Safety is to be applied? ETO ☐ IT ☐ TAW ☐ FT ☐ TC ☐ ITD ☐

Approved and Included in the General Order ☐ Initials _____

Activity # _____

Approved With Changes and Included in the General Order ☐ Initials _____

Changes _____

Not Approved ☐

Requestor Notified NAME: _____ DATE: _____ TIME: _____

Fletcher Hamilton, Director

CLRL GENERAL ORDER

Date: **9/8/2009** **No. 06-356**

This General Order is in effect from 11:59pm Tuesday 9/8/09 until 11:59pm Friday 9/11/09

1. General Items:

RAIL DUTY OFFICER: Tues. 9/8 thru Fri. 9/11 K.Rogers 410-949-5012 Safety Mon. 9/8 thru Sun. 9/20 E.Lewis 443-829-5915 Bus Duty Tues. 9/8 thru Fri. 9/11 A.Morgan 410-454-7098 Cell 443-740-0310 MTA Media Jo Green 410-767-3931 Cell 443-392-2983

2. Special Items:

a) Timonium Fairgrounds- Tues. 9/8 thru Fri. 9/11 Outdoor RV Show / Computer Show

b) Baltimore Convention Center-No Events Tues. 9/8 thru Fri. 9/11

c) Meyerhoff Symphony-No Events Tues. 9/8 thru Fri. 9/11

d) 1st Mariner Arena- Wed. 9/9 Journey Thur. 9/10 & Fri. 9/11 Sesame Street Live

e) M&T Bank Stadium - No Events Tues. 9/8 thru Fri. 9/11

f) Camden Yards-No Events Tues. 9/8 thru Fri. 9/11

g)

Speed Restrictions Until Further Notice ***All Speed Restrictions Apply To Entire Train***

LIMITS	MAX. SPEED TRACK0	MAX. SPEEDTRACK1	MAX. SPEED TRACK2
ML#1&2 Mt. Royal to North Ave./Track Condition	---	10MPH	10MPH
ML#0 Pepper Rd Station to McCormick Rd Station	10MPH		---
ML# 2 Nursery Rd. Station to Patapsco River Bridge			25MPH
---	---	---	---
---	---	---	---

Paul C. Krout

Paul Krout, Red Tag/Work Block Coordinator

MTA CLRL TRACTION & SIGNALS POWER
EQUIPMENT RED TAG REQUEST AUTHORIZATION

Date/Time Received:_____ Request Number: _____

Requester/Company:_____ Office # _____ Home #_____

Red Tag Start- Date:_____ Time:_____ Red Tag Ending- Date:_____ Time:_____

Type of Power Affected: (check) ☐ Catenary Power ☐ 5KV Signals Power ☐ Both

Grade Crossings CUT-OUT: (check) ☐ NO ☐ YES *if YES, refer to CUT-OUT Authorization*_____

Area Affected_____

Work Scheduled_____

Work Block Supervisor:_____ Cell Number or Radio ID:_____

MTA to Install Ground Straps (check) ☐ YES ☐ NO Deliver Red Tag to Location:_____

SUB	BREAKER	Red Tag #	PWR off by/time	PWR on by/time	DEVICE	TO BE OPEN OR CLOSED	Red Tag #	Open or Closed by/time	Open or Closed by/time

Reviewed and Approved:_____ Date: _____ Time _____

Red Tag Acceptance

Possession of this red tag is affirmation that the above listed equipment is locked out. Access to ONLY the area affected above is granted. This form must be returned prior to the end of the work period. Before returning, the holder agrees to verify the affected area is clear of personnel and/or foreign objects. Acceptance of this form constitutes an agreement to the form's conditions.

1-98

Accepted by:_____ Work Phone:_____ Home Phone: _____

Ground Straps: Installer & LOCATIONs:_____ Removed By:_____

Accepted by:_____ Work Phone:_____ Home Phone: _____

Ground Straps: Installer & LOCATIONs:_____ Removed By:_____

Accepted by:_____ Work Phone:_____ Home Phone: _____

Ground Straps: Installer & LOCATIONs:_____ Removed By:_____

MARYLAND TRANSIT ADMINISTRATION
MARYLAND DEPARTMENT OF TRANSPORTATION
Martin O'Malley, Governor • Anthony G. Brown, Lt. Governor
Darrell B. Mobley, Acting Secretary • Ralign T. Wells, Administrator

MEMORANDUM

To: **All MTA Personnel and Contractors**

From: **Mr. Michael Ollinger**
Deputy Director, Light Rail Operations

Date: **January XX, 2013**

Re: **Light Rail Work Block/Red Tag Request Meeting, UPDATE**

Unless otherwise informed, Light Rail Work Block/Red Tag Request Meeting is held every Thursday, 8:00 am at the North Ave Maintenance Facility, 344 W. North Ave, Baltimore, Maryland, 21217. The meeting covers the work requested for the following week, Friday – Thursday.

Any correspondence regarding a request to perform work in the Light Rail right-of-way should be made via:

1. Phone: 410-454-1781
2. Email: MTALRWorkBlock-RedTagRequest@mta.maryland.gov

In an effort to streamline the Light Rail Work Block/Red Tag Request process, completion of these two (2) tasks to gain approval to work on the Light Rail right-of-way:

1. Completed Work Block and Red Tag (if required) request forms submitted via above email no less than 5 days prior to the Light Rail Work Block/Red Tag Request Meeting or 2 weeks prior to start of work.
2. At minimum, the person completing the Work Block request or the Work Crew On-Site Coordinator **must** attend the Light Rail Work Block/Red Tag Request Meeting the week prior to work start.

Failure to complete these tasks will result in denial to perform work.

Thank you for your cooperation.

DRAFT

MTA LIGHT RAIL WORKBLOCK / RED TAG REQUEST FORM

COMPANY:_____ **NAME:**_____

OFFICE PHONE:_____ **HOME PHONE:**_____

WORK SCHEDULED:_____

LOCATION OF WORK:_____

WILL WORK INVOLVE USE OF HI-RAIL VEHICLE: ☐ YES ☐ NO

STARTING WORK DATE: _____ **TIME:**_____

ENDING WORK DATE: _____ **TIME:**_____

Be aware that actual WORKBLOCK & RED TAG start and ending times may vary according to the revenue service schedule. Contact the Light Rail Control Supervisor on duty (410) 454-7590 or 91, 92, for confirmation of WORKBLOCK & RED TAG scheduling times.

WORK CREW ON SITE COORDINATOR:_____**RWP EXP DATE**:_____

RADIO CALL ID: _____ (*If previously assigned*) **CELL PHONE**:_____

WORK CREW IS REQUIRED TO CONTACT LIGHTRAIL CONTROL TO REQUEST AUTHORITY TO ENTER MAINLINE. COMMUNICATION MUST ALSO BE MAINTAINED THROUGHOUT THE WORKBLOCK DURATION, AND UPON COMPLETION OF ALL WORK, THE WORK PARTY MUST REPORT CLEAR OF MAINLINE TRACK AREA. **NOTE: A RED TAG IS NOT A TYPE OF ON-TRACK SAFETY. ALL MEMBERS OF THE WORK CREW MUST HAVE VALID RWP ID AND THE ID'S MUST BE VERIFIED BY THE OSC DURING JOB BRIEFING.**
WORK CREW ON SITE COORDINATOR SIGNATURE: _____

RED TAG REQUIRED: ☐ YES ☐ NO

MTA should deliver RED TAG to work crew at: _____
(specify location: Chain marker, station, or intersection, etc.)

GROUNDING STRAPS: Contractor to provide ☐ MTA requested to provide ☐

SPECIAL NOTES: *(grade crossing cut-outs, escorts, test trains, etc.)*

What type(s) of On-Track Safety is to be applied? ETO ☐ IT ☐ TAW ☐ FT ☐ TC ☐ ITD ☐

Approved and Included in the General Order ☐ Initials _____

Activity # _____

Approved With Changes and Included in the General Order ☐ Initials _____

Changes _____

Not Approved ☐

Requestor Notified NAME: _____ DATE: _____ TIME: _____

APPENDIX D

CONTRACT NO. T-0451-0240

BUY AMERICA REQUIREMENTS

Title 49 - Transportation

PART 661—BUY AMERICA REQUIREMENTS

Section Contents

§ 661.1 Applicability.
§ 661.3 Definitions.
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§ 661.11 Rolling stock procurements.
§ 661.12 Certification requirement for procurement of buses, other rolling stock and associated equipment.
§ 661.13 Grantee responsibility.
§ 661.15 Investigation procedures.
§ 661.17 Failure to comply with certification.
§ 661.18 Intentional violations.
§ 661.19 Sanctions.
§ 661.20 Rights of parties.
§ 661.21 State Buy America provisions.

Authority: 49 U.S.C. 5323(j) (formerly sec. 165 of the Surface Transportation Assistance Act of 1982 (Pub. L. 97–424); as amended by sec. 337, Pub. L. 100–17; sec. 1048, Pub. L. 102–240; sec. 3020(b), Pub. L. 105–178; and sec. 3023(i) and (k), Pub. L. 109–59); 49 CFR 1.51.

Source: 56 FR 932, Jan. 9, 1991, unless otherwise noted.

§ 661.1 Applicability.

Unless otherwise noted, this part applies to all federally assisted procurements using funds authorized by 49 U.S.C. 5323(j); 23 U.S.C. 103(e)(4); and section 14 of the National Capital Transportation Act of 1969, as amended.

[56 FR 932, Jan. 9, 1991, as amended at 72 FR 53696, Sept. 20, 2007]

§ 661.3 Definitions.

As used in this part:

Act means the Federal Public Transportation Law (49 U.S.C. Chapter 53).

Administrator means the Administrator of FTA, or designee.

Component means any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into the end product at the final assembly location.

Contractor means a party to a third party contract other than the grantee.

End product means any vehicle, structure, product, article, material, supply, or system, which directly incorporates constituent components at the final assembly location, that is acquired for public use under a federally-funded third-party contract, and which is ready to provide its

intended end function or use without any further manufacturing or assembly change(s). A list of representative end products is included at Appendix A to this section.

FTA means the Federal Transit Administration.

Grantee means any entity that is a recipient of FTA funds.

Manufactured product means an item produced as a result of the manufacturing process.

Manufacturing process means the application of processes to alter the form or function of materials or of elements of the product in a manner adding value and transforming those materials or elements so that they represent a new end product functionally different from that which would result from mere assembly of the elements or materials.

Negotiated procurement means a contract awarded using other than sealed bidding procedures.

Rolling stock means transit vehicles such as buses, vans, cars, railcars, locomotives, trolley cars and buses, and ferry boats, as well as vehicles used for support services.

System means a machine, product, or device, or a combination of such equipment, consisting of individual components, whether separate or interconnected by piping, transmission devices, electrical cables or circuitry, or by other devices, which are intended to contribute together to a clearly defined function. Factors to consider in determining whether a system constitutes an end product include: Whether performance warranties apply to an integrated system (regardless of whether components are separately warranteed); whether products perform on an integrated basis with other products in a system, or are operated independently of associated products in the system; or whether transit agencies routinely procure a product separately (other than as replacement or spare parts).

United States means the several States, the Commonwealth of Puerto Rico, the District of Columbia, Guam, American Samoa, the U.S. Virgin Islands, and the Commonwealth of the Northern Mariana Islands.

Appendix A to §661.3—End Products

The following is a list of representative end products that are subject to the requirements of Buy America. This list is representative, not exhaustive.

(1) *Rolling stock end products:* All individual items identified as rolling stock in §661.3 (*e.g.,* buses, vans, cars, railcars, locomotives, trolley cars and buses, ferry boats, as well as vehicles used for support services); train control, communication, and traction power equipment that meets the definition of end product at §661.3 (*e.g.,* a communication or traction power system, including manufactured bimetallic power rail).

(2) *Steel and iron end products:* Items made primarily of steel or iron such as structures, bridges, and track work, including running rail, contact rail, and turnouts.

(3) *Manufactured end products:* Infrastructure projects not made primarily of steel or iron, including structures (terminals, depots, garages, and bus shelters), ties and ballast; contact rail not made primarily of steel or iron; fare collection systems; computers; information systems; security systems; data processing systems; and mobile lifts, hoists, and elevators.

[72 FR 53696, Sept. 20, 2007, as amended at 74 FR 30239, June 25, 2009]

§ 661.5 General requirements.

(a) Except as provided in §661.7 and §661.11 of this part, no funds may be obligated by FTA for a grantee project unless all iron, steel, and manufactured products used in the project are produced in the United States.

(b) All steel and iron manufacturing processes must take place in the United States, except metallurgical processes involving refinement of steel additives.

(c) The steel and iron requirements apply to all construction materials made primarily of steel or iron and used in infrastructure projects such as transit or maintenance facilities, rail lines, and bridges. These items include, but are not limited to, structural steel or iron, steel or iron beams and columns, running rail and contact rail. These requirements do not apply to steel or iron used as components or subcomponents of other manufactured products or rolling stock, or to bimetallic power rail incorporating steel or iron components.

(d) For a manufactured product to be considered produced in the United States:

(1) All of the manufacturing processes for the product must take place in the United States; and

(2) All of the components of the product must be of U.S. origin. A component is considered of U.S. origin if it is manufactured in the United States, regardless of the origin of its subcomponents.

[61 FR 6302, Feb. 16, 1996, as amended at 74 FR 30239, June 25, 2009]

§ 661.6 Certification requirements for procurement of steel or manufactured products.

If steel, iron, or manufactured products (as defined in §§661.3 and 661.5 of this part) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each bidder or offeror in accordance with the requirement contained in §661.13(b) of this part.

Certificate of Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j)(1), and the applicable regulations in 49 CFR part 661.

Date_____
Signature_____
Company_____
Name_____
Title_____

Certificate of Non-Compliance with Buy America Requirements

The bidder or offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but it may qualify for an exception to the requirement pursuant to 49 U.S.C. 5323(j)(2), as amended, and the applicable regulations in 49 CFR 661.7.

Date_____
Signature_____
Company_____

Name_____
Title_____

[71 FR 14117, Mar. 21, 2006, as amended at 72 FR 53696, Sept. 20, 2007]

§ 661.7 Waivers.

(a) Section 5323(j)(2) of Title 49 United States Code provides that the general requirements of 49 U.S.C. 5323(j)(1) shall not apply in four specific instances. This section sets out the conditions for the three statutory waivers based on public interest, non-availability, and price-differential. Section 661.11 of this part sets out the conditions for the fourth statutory waiver governing the procurement of rolling stock and associated equipment.

(b) Under the provision of 49 U.S.C. 5323(j)(2)(A), the Administrator may waive the general requirements of 49 U.S.C. 5323(j)(1) if the Administrator finds that their application would be inconsistent with the public interest. In determining whether the conditions exist to grant this public interest waiver, the Administrator will consider all appropriate factors on a case-by-case basis, unless a general exception is specifically set out in this part. When granting a public interest waiver, the Administrator shall issue a detailed written statement justifying why the waiver is in the public interest. The Administrator shall publish this justification in the Federal Register providing the public with a reasonable time for notice and comment of not more than seven calendar days.

(c) Under the provision of 49 U.S.C. 5323(j)(2), the Administrator may waive the general requirements of 49 U.S.C. 5323(j) if the Administrator finds that the materials for which a waiver is requested are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.

(1) It will be presumed that the conditions exist to grant this non-availability waiver if no responsive and responsible bid is received offering an item produced in the United States.

(2) In the case of a sole source procurement, the Administrator will grant this non-availability waiver only if the grantee provides sufficient information which indicates that the item to be procured is only available from a single source or that the item to be procured is not produced in sufficient and reasonably available quantities of a satisfactory quality in the United States.

(3) After contract award, the Administrator may grant a non-availability waiver under this paragraph, in any case in which a bidder or Offeror originally certified compliance with the Buy America requirements in good faith, but can no longer comply with its certification. The Administrator will grant a non-availability waiver only if the grantee provides sufficient evidence that the original certification was made in good faith and that the item to be procured cannot now be obtained domestically due to commercial impossibility or impracticability. In determining whether the conditions exist to grant a post-award non-availability waiver, the Administrator will consider all appropriate factors on a case-by-case basis.

(d) Under the provision of section 165(b)(4) of the Act, the Administrator may waive the general requirements of section 165(a) if the Administrator finds that the inclusion of a domestic item or

domestic material will increase the cost of the contract between the grantee and its supplier of that item or material by more than 25 percent. The Administrator will grant this price-differential waiver if the amount of the lowest responsive and responsible bid offering the item or material that is not produced in the United States multiplied by 1.25 is less than the amount of the lowest responsive and responsible bid offering the item or material produced in the United States.

(e) The four statutory waivers of 49 U.S.C. 5323(j)(2) as set out in this part shall be treated as being separate and distinct from each other.

(f) The waivers described in paragraphs (b) and (c) of this section may be granted for a component or subcomponent in the case of the procurement of the items governed by 49 U.S.C. 5323(j)(2)(C) (requirements for rolling stock). If a waiver is granted for a component or a subcomponent, that component or subcomponent will be considered to be of domestic origin for the purposes of §661.11 of this part.

(g) The waivers described in paragraphs (b) and (c) of this section may be granted for a specific item or material that is used in the production of a manufactured product that is governed by the requirements of §661.5(d) of this part. If such a waiver is granted to such a specific item or material, that item or material will be treated as being of domestic origin.

(h) The provisions of this section shall not apply to products produced in a foreign country if the Secretary, in consultation with the United States Trade Representative, determines that:

(1) That foreign country is party to an agreement with the United States pursuant to which the head of an agency of the United States has waived the requirements of this section; and

(2) That foreign country has violated the terms of the agreement by discriminating against products covered by this section that are produced in the United States and are covered by the agreement.

Appendix A to §661.7—General Waivers

(a) All waivers published in 48 CFR 25.104 which establish excepted articles, materials, and supplies for the Buy American Act of 1933 (41 U.S.C. 10a–d), as the waivers may be amended from time to time, apply to this part under the provisions of §661.7 (b) and (c).

(b) Under the provisions of §661.7 (b) and (c) of this part, a general public interest waiver from the Buy America requirements applies to microprocessors, computers, microcomputers, or software, or other such devices, which are used solely for the purpose of processing or storing data. This general waiver does not extend to a product or device which merely contains a microprocessor or microcomputer and is not used solely for the purpose of processing or storing data.

(c) Under the provisions of §661.7(b) of this part, a general public interest waiver from the Buy America requirements for “small purchases” (as defined in the “common grant rule,” at 49 CFR 18.36(d)) made by FTA grantees with capital, planning, or operating assistance.

[56 FR 932, Jan. 9, 1991, as amended at 60 FR 37928, July 24, 1995, 61 FR 6302, Feb. 16, 1996; 71 FR 14117, Mar. 21, 2006; 72 FR 53697, Sept. 20, 2007; 74 FR 30239, June 25, 2009]

§ 661.9 Application for waivers.

(a) This section sets out the application procedures for obtaining all waivers, except those general exceptions set forth in this part for which individual applications are unnecessary and

those covered by 49 U.S.C. 5323(j)(2)(C). The procedures for obtaining an exception covered by 49 U.S.C. 5323(j)(2)(C) are set forth in §661.11 of this part.

(b) A bidder or Offeror who seeks to establish grounds for an exception must seek the exception, in a timely manner, through the grantee.

(c) Except as provided in paragraph (d) of this section, only a grantee may request a waiver. The request must be in writing, include facts and justification to support the waiver, and be submitted to the Administrator through the appropriate Regional Office.

(d) FTA will consider a request for a waiver from a potential bidder, Offeror, or supplier only if the waiver is being sought under §661.7 (f) or (g) of this part.

(e) The Administrator will issue a written determination setting forth the reasons for granting or denying the exception request. Each request for an exception, and FTA's action on the request, are available for public inspection under the provisions of 49 CFR part 601, subpart C.

[56 FR 932, Jan. 9, 1991, as amended at 71 FR 14117, Mar. 21, 2006; 72 FR 53697, Sept. 20, 2007]

§ 661.11 Rolling stock procurements.

(a) The provisions of §661.5 do not apply to the procurement of buses and other rolling stock (including train control, communication, and traction power equipment), if the cost of components produced in the United States is more than 60 percent of the cost of all components and final assembly takes place in the United States.

(b) The domestic content requirements in paragraph (a) of this section also apply to the domestic content requirements for components set forth in paragraphs (i), (j), and (l) of this section.

(c) A component is any article, material, or supply, whether manufactured or unmanufactured, that is directly incorporated into an end product at the final assembly location.

(d) A component may be manufactured at the final assembly location if the manufacturing process to produce the component is an activity separate and distinct from the final assembly of the end product.

(e) A component is considered to be manufactured if there are sufficient activities taking place to advance the value or improve the condition of the subcomponents of that component; that is, if the subcomponents have been substantially transformed or merged into a new and functionally different article.

(f) Except as provided in paragraph (k) of this section, a subcomponent is any article, material, or supply, whether manufactured or unmanufactured, that is one step removed from a component (as defined in paragraph (c) of this section) in the manufacturing process and that is incorporated directly into a component.

(g) For a component to be of domestic origin, more that 60 percent of the subcomponents of that component, by cost, must be of domestic origin, and the manufacture of the component must take place in the United States. If, under the terms of this part, a component is determined to be

of domestic origin, its entire cost may be used in calculating the cost of domestic content of an end product.

(h) A subcomponent is of domestic origin if it is manufactured in the United States.

(i) If a subcomponent manufactured in the United States is exported for inclusion in a component that is manufactured outside the United States and it receives tariff exemptions under the procedures set forth in 19 CFR 10.11 through 10.24, the subcomponent retains its domestic identity and can be included in the calculation of the domestic content of an end product even if such a subcomponent represents less than 60 percent of the cost of a particular component.

(j) If a subcomponent manufactured in the United States is exported for inclusion in a component manufactured outside the United States and it does not receive tariff exemption under the procedures set forth in 19 CFR 10.11 through 10.24, the subcomponent loses its domestic identity and cannot be included in the calculation of the domestic content of an end product.

(k) Raw materials produced in the United States and then exported for incorporation into a component are not considered to be a subcomponent for the purpose of calculating domestic content. The value of such raw materials is to be included in the cost of the foreign component.

(l) If a component is manufactured in the United States, but contains less than 60 percent domestic subcomponents, by cost, the cost of the domestic subcomponents and the cost of manufacturing the component may be included in the calculation of the domestic content of the end product.

(m) For purposes of this section, except as provided in paragraph (o) of this section:

(1) The cost of a component or a subcomponent is the price that a bidder or Offeror must pay to a subcontractor or supplier for that component or subcomponent. Transportation costs to the final assembly location must be included in calculating the cost of foreign components and subcomponents.

(2) If a component or subcomponent is manufactured by the bidder or Offeror, the cost of the component is the cost of labor and materials incorporated into the component or subcomponent, an allowance for profit, and the administrative and overhead costs attributable to that component or subcomponent under normal accounting principles.

(n) The cost of a component of foreign origin is set using the foreign exchange rate at the time the bidder or Offeror executes the appropriate Buy America certificate.

(o) The cost of a subcomponent that retains its domestic identity consistent with paragraph (j) of this section shall be the cost of the subcomponent when last purchased, f.o.b. United States port of exportation or point of border crossing as set out in the invoice and entry papers or, if no purchase was made, the value of the subcomponent at the time of its shipment for exportation, f.o.b. United States port of exportation or point of border crossing as set out in the invoice and entry papers.

(p) In accordance with 49 U.S.C. 5323(j), labor costs involved in final assembly shall not be included in calculating component costs.

(q) The actual cost, not the bid price, of a component is to be considered in calculating domestic content.

(r) Final assembly is the creation of the end product from individual elements brought together for that purpose through application of manufacturing processes. If a system is being procured as the end product by the grantee, the installation of the system qualifies as final assembly.

(s) [Reserved]

(t) Train control equipment includes, but is not limited to, the following equipment:

(1) Mimic board in central control

(2) Dispatcher's console

(3) Local control panels

(4) Station (way side) block control relay cabinets

(5) Terminal dispatcher machines

(6) Cable/cable trays

(7) Switch machines

(8) Way side signals

(9) Impedance bonds

(10) Relay rack bungalows

(11) Central computer control

(12) Brake equipment

(13) Brake systems

(14) Cab Signaling;

(15) ATO Equipment;

(16) ATP Equipment;

(17) Wayside Transponders;

(18) Trip Stop Equipment;

(19) Wayside Magnets;

(20) Speed Measuring Devices;

(21) Car Axle Counters;

(22) Communication Based Train Control (CBTC).

(u) Communication equipment includes, but is not limited to, the following equipment:

(1) Radios

(2) Space station transmitter and receivers

(3) Vehicular and hand-held radios

(4) PABX telephone switching equipment

(5) PABX telephone instruments

(6) Public address amplifiers

(7) Public address speakers

(8) Cable transmission system cable

(9) Cable transmission system multiplex equipment

(10) Communication console at central control

(11) Uninterruptible power supply inverters/rectifiers

(12) Uninterruptible power supply batteries

(13) Data transmission system central processors

(14) Data transmission system remote terminals

(15) Line printers for data transmission system

(16) Communication system monitor test panel

(17) Security console at central control

(18) Antennas;

(19) Wireless Telemetry Equipment;

(20) Passenger Information Displays;

(21) Communications Control Units;

(22) Communication Control Heads;

(23) Wireless Intercar Transceivers;

(24) Multiplexers;

(25) SCADA Systems;

(26) LED Arrays;

(27) Screen Displays such as LEDs and LCDs for communication systems;

(28) Fiber-optic transmission equipment;

(29) Fiber-optic transmission equipment;

(30) Frame or cell based multiplexing equipment; 13) Communication system network elements.

(v) Traction power equipment includes, but is not limited to the following:

(1) Primary AC switch gear

(2) Primary AC transformer rectifiers

(3) DC switch gear

(4) Traction power console and CRT display system at central control

(5) Bus ducts with buses (AC and DC)

(6) Batteries

(7) Traction power rectifier assemblies

(8) Distribution panels (AC and DC)

(9) Facility step-down transformers

(10) Motor control centers (facility use only)

(11) Battery chargers

(12) Supervisory control panel

(13) Annunciator panels

(14) Low voltage facility distribution switch board

(15) DC connect switches

(16) Negative bus boxes

(17) Power rail insulators

(18) Power cables (AC and DC)

(19) Cable trays

(20) Instrumentation for traction power equipment

(21) Connectors, tensioners, and insulators for overhead power wire systems

(22) Negative drainage boards

(23) Inverters

(24) Traction motors

(25) Propulsion gear boxes

(26) Third rail pick-up equipment

(27) Pantographs

(28) Propulsion Control Systems;

(29) Surge Arrestors;

(30) Protective Relaying.

(31) Bimetallic power rail.

(w) The power or third rail is not considered traction power equipment and is thus subject to the requirements of 49 U.S.C. 5323(j) and the requirements of §661.5.

(x) A bidder on a contract for an item covered by 49 U.S.C. 5323(j) who will comply with section 165(b)(3) and regulations in this section is not required to follow the application for waiver procedures set out in §661.9. In lieu of these procedures, the bidder must submit the appropriate certificate required by §661.12.

Appendix A to §661.11—General Waivers

(a) The provisions of §661.11 of this part do not apply when foreign sourced spare parts for buses and other rolling stock (including train control, communication, and traction power equipment) whose total cost is 10 percent or less of the overall project contract cost are being procured as part of the same contract for the major capital item.

(b) [Reserved]

Appendix B to §661.11—Typical Components of Buses

The following is a list of items that typically would be considered components of a bus. This list is not all-inclusive.

Car body shells, engines, transmissions, front axle assemblies, rear axle assemblies, drive shaft assemblies, front suspension assemblies, rear suspension assemblies, air compressor and pneumatic systems, generator/alternator and electrical systems, steering system assemblies, front and rear air brake assemblies, air conditioning compressor assemblies, air conditioning evaporator/condenser assemblies, heating systems. passenger seats, driver's seat assemblies, window assemblies, entrance and exit door assemblies, door control systems, destination sign assemblies, interior lighting assemblies, front and rear end cap assemblies, front and rear bumper assemblies, specialty steel (structural steel tubing, etc.) aluminum extrusions, aluminum, steel or fiberglass exterior panels, and interior trim, flooring, and floor coverings.

Appendix C to §661.11—Typical Components of Rail Rolling Stock

The following is a list of items that typically would be considered components of rail rolling stock. This list is not all inclusive.

Car shells, engines, main transformer, pantographs, traction motors, propulsion gear boxes, interior linings, acceleration and braking resistors, propulsion controls, low voltage auxiliary power supplies, air conditioning equipment, air brake compressors, brake controls, foundation brake equipment, articulation assemblies, train control systems, window assemblies, communication equipment, lighting, seating, doors, door actuators and controls, wheelchair lifts and ramps to make the vehicle accessible to persons with disabilities, couplers and draft gear, trucks, journal bearings, axles, diagnostic equipment, and third rail pick-up equipment.

Appendix D to §661.11—Minimum Requirements for Final Assembly

(a) Rail Cars: In the case of the manufacture of a new rail car, final assembly would typically include, as a minimum, the following operations: installation and interconnection of propulsion control equipment, propulsion cooling equipment, brake equipment, energy sources for auxiliaries and controls, heating and air conditioning, communications equipment, motors, wheels and axles, suspensions and frames; the inspection and verification of all installation and interconnection work; and the in-plant testing of the stationary product to verify all functions.

(b) Buses: In the case of a new bus, final assembly would typically include, at a minimum, the installation and interconnection of the engine, transmission, axles, including the cooling and braking systems; the installation and interconnection of the heating and air conditioning equipment; the installation of pneumatic and electrical systems, door systems, passenger seats, passenger grab rails, destination signs, wheelchair lifts; and road testing, final inspection, repairs and preparation of the vehicles for delivery.

(c) If a manufacturer's final assembly processes do not include all the activities that are typically considered the minimum requirements, it can request a Federal Transit Administration (FTA) determination of compliance. FTA will review these requests on a case-by-case basis to determine compliance with Buy America.

[61 FR 6302, Feb. 16, 1996, as amended at 62 FR 40954, July 31, 1997; 72 FR 53697, Sept. 20, 2007; 72 FR 55103, Sept. 28, 2007; 74 FR 30239, June 25, 2009]

§ 661.12 Certification requirement for procurement of buses, other rolling stock and associated equipment.

If buses or other rolling stock (including train control, communication, and traction power equipment) are being procured, the appropriate certificate as set forth below shall be completed and submitted by each bidder in accordance with the requirement contained in §661.13(b) of this part.

Certificate of Compliance with Buy America Rolling Stock Requirements

The bidder or Offeror hereby certifies that it will comply with the requirements of 49 U.S.C. 5323(j), and the applicable regulations of 49 CFR 661.11.

Date_____
Signature_____
Company_____
Name_____
Title_____

Certificate of Non-Compliance with Buy America Rolling Stock Requirements

The bidder or Offeror hereby certifies that it cannot comply with the requirements of 49 U.S.C. 5323(j), but may qualify for an exception to the requirement consistent with 49 U.S.C. 5323(j)(2)(C), and the applicable regulations in 49 CFR 661.7.

Date_____
Signature_____
Company_____
Name_____
Title_____

[71 FR 14117, Mar. 21, 2006, as amended at 72 FR 53698, Sept. 20, 2007; 74 FR 30239, June 25, 2009]

§ 661.13 Grantee responsibility.

(a) The grantee shall adhere to the Buy America clause set forth in its grant contract with FTA.

(b) The grantee shall include in its bid or request for proposal (RFP) specification for procurement within the scope of this part an appropriate notice of the Buy America provision. Such specifications shall require, as a condition of responsiveness, that the bidder or Offeror submit with the bid or offer a completed Buy America certificate in accordance with §§661.6 or 661.12 of this part, as appropriate.

(1) A bidder or Offeror who has submitted an incomplete Buy America certificate or an incorrect certificate of noncompliance through inadvertent or clerical error (but not including failure to sign the certificate, submission of certificates of both compliance and non-compliance, or failure to submit any certification), may submit to the FTA Chief Counsel within ten (10) days of bid opening of submission or a final offer, a written explanation of the circumstances surrounding the submission of the incomplete or incorrect certification in

accordance with 28 U.S.C. 1746, sworn under penalty of perjury, stating that the submission resulted from inadvertent or clerical error. The bidder or Offeror will also submit evidence of intent, such as information about the origin of the product, invoices, or other working documents. The bidder or Offeror will simultaneously send a copy of this information to the FTA grantee.

(i) The FTA Chief Counsel may request additional information from the bidder or Offeror, if necessary. The grantee may not make a contract award until the FTA Chief Counsel issues his/her determination, except as provided in §661.15(m).

(ii) [Reserved]

(2) For negotiated procurements, compliance with the Buy America requirements shall be determined on the basis of the certification submitted with the final offer or final revised proposal. However, where a grantee awards on the basis of initial proposals without discussion, the certification submitted with the initial proposal shall control.

(3) Certification based on ignorance of the proper application of the Buy America requirements is not an inadvertent or clerical error.

(c) Whether or not a bidder or Offeror certifies that it will comply with the applicable requirement, such bidder or Offeror is bound by its original certification (in the case of a sealed bidding procurement) or its certification submitted with its final offer (in the case of a negotiated procurement) and is not permitted to change its certification after bid opening or submission of a final offer. Where a bidder or Offeror certifies that it will comply with the applicable Buy America requirements, the bidder, Offeror, or grantee is not eligible for a waiver of those requirements.

[56 FR 932, Jan. 9, 1991, as amended at 68 FR 9799, Feb. 28, 2003; 71 FR 14117, Mar. 21, 2006]

§ 661.15 Investigation procedures.

(a) It is presumed that a bidder or Offeror who has submitted the required Buy America certificate is complying with the Buy America provision. A false certification is a criminal act in violation of 18 U.S.C. 1001.

(b) Any party may petition FTA to investigate the compliance of a successful bidder or Offeror with the bidder's or Offeror's certification. That party ("the petitioner") must include in the petition a statement of the grounds of the petition and any supporting documentation. If FTA determines that the information presented in the petition indicates that the presumption in paragraph (a) of this section has been overcome, FTA will initiate an investigation.

(c) In appropriate circumstances, FTA may determine on its own to initiate an investigation without receiving a petition from a third party.

(d) When FTA determines under paragraph (b) or (c) of this section to conduct an investigation, it requests that the grantee require the successful bidder or Offeror to document its compliance with its Buy America certificate. The successful bidder or Offeror has the burden of proof to establish that it is in compliance. Documentation of compliance is based on the specific

circumstances of each investigation, and FTA will specify the documentation required in each case.

(e) The grantee shall reply to the request under paragraph (d) of this section within 15 working days of the request. The investigated party may correspond directly with FTA during the course of investigation, if it informs the grantee that it intends to do so, and if the grantee agrees to such action in writing. The grantee must inform FTA, in writing that the investigated party will respond directly to FTA. An investigated party may provide confidential or proprietary information (see paragraph (l) of this section) directly to FTA while providing other information required to be submitted as part of the investigation through the grantee.

(f) Any additional information requested or required by FTA must be submitted within 5 working days after the receipt of such request unless specifically exempted by FTA.

(g) The grantee's reply (or that of the bidder or Offeror) will be transmitted to the petitioner. The petitioner may submit comments on the reply to FTA within 10 working days after receipt of the reply. The grantee and the low bidder or Offeror will be furnished with a copy of the petitioner's comments, and their comments must be received by FTA within 5 working days after receipt of the petitioner's comments.

(h) The failure of a party to comply with the time limits stated in this section may result in resolution of the investigation without consideration of untimely filed comments.

(i) During the course of an investigation, with appropriate notification to affected parties, FTA may conduct site visits of manufacturing facilities and final assembly locations as it considers appropriate.

(j) FTA will, upon request, make available to any interested party information bearing on the substance of the investigation which has been submitted by the petitioner, interested parties or grantees, except to the extent that withholding of information is permitted or required by law or regulation.

(k) If a party submitting information considers that the information submitted contains proprietary material which should be withheld, a statement advising FTA of this fact may be included, and the alleged proprietary information must be identified wherever it appears. Any comments on the information provided shall be submitted within a maximum of ten days.

(l) For purposes of paragraph (j) of this section, confidential or proprietary material is any material or data whose disclosure could reasonably be expected to cause substantial competitive harm to the party claiming that the material is confidential or proprietary.

(m) When a petition for investigation has been filed before award, the grantee will not make an award before the resolution of the investigation, unless the grantee determines that:

(1) The items to be procured are urgently required;

(2) Delivery of performance will be unduly delayed by failure to make the award promptly; or

(3) Failure to make prompt award will otherwise cause undue harm to the grantee or the Federal Government.

(n) In the event that the grantee determines that the award is to be made during the pendency of an investigation, the grantee will notify FTA before to making such award. FTA reserves the right not to participate in the funding of any contract awarded during the pendency of an investigation.

(o) Initial decisions by FTA will be in written form. Reconsideration of an initial decision of FTA may be requested by any party involved in an investigation. FTA will only reconsider a decision only if the party requesting reconsideration submits new matters of fact or points of law that were not known or available to the party during the investigation. A request for reconsideration of a decision of FTA shall be filed not later than ten (10) working days after the initial written decision. A request for reconsideration will be subject to the procedures in this section consistent with the need for prompt resolution of the matter.

[56 FR 932, Jan. 9, 1991, as amended at 71 FR 14118, Mar. 21, 2006]

§ 661.17 Failure to comply with certification.

If a successful bidder or Offeror fails to demonstrate that it is in compliance with its certification, it will be required to take the necessary steps in order to achieve compliance. If a bidder or Offeror takes these necessary steps, it will not be allowed to change its original bid price or the price of its final offer. If a bidder or Offeror does not take the necessary steps, it will not be awarded the contract if the contract has not yet been awarded, and it is in breach of contract if a contract has been awarded.

[71 FR 14118, Mar. 21, 2006]

§ 661.18 Intentional violations.

A person shall be ineligible to receive any contract or subcontract made with funds authorized under the Federal Public Transportation Act of 2005 pursuant to part 29 of this title if it has been determined by a court or Federal agency that the person intentionally—

(a) Affixed a label bearing a “Made in America” inscription, or an inscription with the same meaning, to a product not made in the United States, but sold in or shipped to the United States and used in projects to which this section applies, or

(b) Otherwise represented that any such product was produced in the United States.

[61 FR 6303, Feb. 16, 1996, as amended at 72 FR 53698, Sept. 20, 2007]

§ 661.19 Sanctions.

A willful refusal to comply with a certification by a successful bidder or Offeror may lead to the initiation of debarment or suspension proceedings under part 29 of this title.

[71 FR 14118, Mar. 21, 2006]

§ 661.20 Rights of parties.

(a) A party adversely affected by an FTA action under this subsection shall have the right to seek review under the Administrative Procedure Act (APA), 5 U.S.C. 702 *et seq.*

(b) Except as provided in paragraph (a) of this section, the sole right of any third party under the Buy America provision is to petition FTA under the provisions of §661.15 of this part. No third party has any additional right, at law or equity, for any remedy including, but not limited to, injunctions, damages, or cancellation of the Federal grant or contracts of the grantee.

[71 FR 14118, Mar. 21, 2006]

§ 661.21 State Buy America provisions.

(a) Except as provided in paragraph (b) of this section, any State may impose more stringent Buy America or buy national requirements than contained in section 165 of the Act and the regulations in this part.

(b) FTA will not participate in contracts governed by the following:

(1) State Buy America or Buy National preference provisions which are not as strict as the Federal requirements.

(2) State and local Buy National or Buy America preference provisions which are not explicitly set out under State law. For example, administrative interpretations of non-specific State legislation will not control.

(3) State and local Buy Local preference provisions.

PART 663—PRE-AWARD AND POST-DELIVERY AUDITS OF ROLLING STOCK PURCHASES

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Authority: 49 U.S.C. 1608(j); 23 U.S.C. 103(e)(f); Pub. L. 96–184, 93 Stat. 1320; Pub. L. 101–551, 104 Stat. 2733; sec. 3023(m), Pub. L. 109–59; 49 CFR 1.51.
Source: 56 FR 48395, Sept. 24, 1991, unless otherwise noted.

Subpart A—General

§ 663.1 Purpose.

This part implements section 12(j) of the Federal Mass Transit Act of 1964, as amended, which was added by section 319 of the 1987 Surface Transportation and Uniform Relocation Assistance Act (Pub. L. 100–17). Section 12(j) requires the Federal Transit Administration, by delegation from the Secretary of Transportation, to issue regulations requiring pre-award and post-delivery audits when a recipient of Federal financial assistance purchases rolling stock with funds made available under the Federal Mass Transit Act, as amended.

§ 663.3 Scope.

This part applies to a recipient purchasing rolling stock to carry passengers in revenue service with funds made available under sections 3, 9, 18, and 16(b)(2) of the Federal Mass Transit Act, as amended; 23 U.S.C. 103(e)(4); and section 14 of the National Capital Transportation Act of 1969, as amended.

§ 663.5 Definitions.

As used in this part—

(a) *Pre-award* means that period in the procurement process before the recipient enters into a formal contract with the supplier.

(b) *Post-delivery* means the time period in the procurement process from when the rolling stock is delivered to the recipient until title to the rolling stock is transferred to the recipient or the rolling stock is put into revenue service, whichever is first.

(c) *Recipient* means a recipient of Federal financial assistance from FTA.

(d) *Revenue service* means operation of rolling stock for transportation of fare-paying passengers as anticipated by the recipient.

(e) *Rolling stock* means buses, vans, cars, railcars, locomotives, trolley cars and buses, ferry boats, and vehicles used for guide ways and incline planes.

(f) *Audit* means a review resulting in a report containing the necessary certifications of compliance with Buy America standards, purchaser's requirements specifications, and, where appropriate, a manufacturer's certification of compliance with or inapplicability of the Federal Motor Vehicle Safety Standards, required by section 319 of STURAA and this part.

(g) *FTA* means the Federal Transit Administration.

§ 663.7 Certification of compliance to FTA.

A recipient purchasing revenue service rolling stock with funds obligated by FTA on or after October 24, 1991, must certify to FTA that it will conduct or cause to be conducted pre-award and post-delivery audits as prescribed in this part. In addition, such a recipient must maintain on file the certifications required under subparts B, C, and D of this part.

§ 663.9 Audit limitations.

(a) An audit under this part is limited to verifying compliance with

(1) Applicable Buy America requirements [section 165 of the Surface Transportation Assistance Act of 1982, as amended,]; and

(2) Solicitation specification requirements of the recipient.

(b) An audit under this part includes, where appropriate, a copy of a manufacturer's self certification information that the vehicle complies with Federal Motor Vehicle Safety Standards or a certification that such standards are inapplicable.

(c) An audit conducted under this part is separate from the single annual audit requirement established by Office of Management and Budget Circular A–128, “Audits of State and Local Governments,” dated May 16, 1985.

§ 663.11 Audit financing.

A recipient purchasing revenue rolling stock with FTA funds may charge the cost of activities required by this part to the grant which FTA made for such purchase.

§ 663.13 Buy America requirements.

A Buy America certification under this part shall be issued in addition to any certification which may be required by part 661 of this title. Nothing in this part precludes FTA from conducting a Buy America investigation under part 661 of this title.

§ 663.15 Compliance.

A recipient subject to this part shall comply with all applicable requirements of this part. Such compliance is a condition of receiving Federal financial assistance from FTA. A recipient determined not to be in compliance with this part will be subject to the immediate suspension, withholding, or repayment of Federal financial assistance from FTA or other appropriate actions unless and until it comes into compliance with this part.

Subpart B—Pre-Award Audits

§ 663.21 Pre-award audit requirements.

A recipient purchasing revenue service rolling stock with FTA funds must ensure that a pre-award audit under this part is complete before the recipient enters into a formal contract for the purchase of such rolling stock.

§ 663.23 Description of pre-award audit.

A pre-award audit under this part includes—

(a) A Buy America certification as described in §663.25 of this part;

(b) A purchaser's requirements certification as described in §663.27 of this part; and

(c) Where appropriate, a manufacturer's Federal Motor Vehicle Safety certification information as described in §663.41 or §663.43 of this part.

§ 663.25 Pre-award Buy America certification.

For purposes of this part, a pre-award Buy America certification is a certification that the recipient keeps on file that—

(a) There is a letter from FTA which grants a waiver to the rolling stock to be purchased from the Buy America requirements under section 165(b)(1), (b)(2), or (b)(4) of the Surface Transportation Assistance Act of 1982, as amended; or

(b) The recipient is satisfied that the rolling stock to be purchased meets the requirements of section 165(a) or (b)(3) of the Surface Transportation Assistance Act of 1982, as amended, after having reviewed itself or through an audit prepared by someone other than the manufacturer or its agent documentation provided by the manufacturer which lists—

(1) Component and subcomponent parts of the rolling stock to be purchased identified by manufacturer of the parts, their country of origin and costs; and

(2) The location of the final assembly point for the rolling stock, including a description of the activities that will take place at the final assembly point and the cost of final assembly.

§ 663.27 Pre-award purchaser's requirements certification.

For purposes of this part, a pre-award purchaser's requirements certification is a certification a recipient keeps on file that—

(a) The rolling stock the recipient is contracting for is the same product described in the purchaser's solicitation specification; and

(b) The proposed manufacturer is a responsible manufacturer with the capability to produce a vehicle that meets the recipient's specification set forth in the recipient's solicitation.

Subpart C—Post-Delivery Audits

§ 663.31 Post-delivery audit requirements.

A recipient purchasing revenue service rolling stock with FTA funds must ensure that a post-delivery audit under this part is complete before title to the rolling stock is transferred to the recipient.

§ 663.33 Description of post-delivery audit.

A post-delivery audit under this part includes—

(a) A post-delivery Buy America certification as described in §663.35 of this part;

(b) A post-delivery purchaser's requirements certification as described in §663.37 of this part; and

(c) When appropriate, a manufacturer's Federal Motor Vehicle Safety Standard self-certification information as described in §663.41 or §663.43 of this part.

§ 663.35 Post-delivery Buy America certification.

For purposes of this part, a post-delivery Buy America certification is a certification that the recipient keeps on file that—

(a) There is a letter from FTA which grants a waiver to the rolling stock received from the Buy America requirements under sections 165 (b)(1), or (b)(4) of the Surface Transportation Assistance Act of 1982, as amended; or

(b) The recipient is satisfied that the rolling stock received meets the requirements of section 165 (a) or (b)(3) of the Surface Transportation Assistance Act of 1982, as amended, after having reviewed itself or by means of an audit prepared by someone other than the manufacturer or its agent documentation provided by the manufacturer which lists—

(1) Components and subcomponent parts of the rolling stock identified by manufacturer of the parts, their country of origin and costs; and

(2) The actual location of the final assembly point for the rolling stock including a description of the activities which took place at the final assembly point and the cost of the final assembly.

§ 663.37 Post-delivery purchaser's requirements certification.

For purposes of this part, a post-delivery purchaser's requirements certification is a certification that the recipient keeps on file that—

(a) Except for procurements covered under paragraph (c) in this section, a resident inspector (other than an agent or employee of the manufacturer) was at the manufacturing site throughout the period of manufacture of the rolling stock to be purchased and monitored and completed a report on the manufacture of such rolling stock. Such a report, at a minimum, shall—

(1) Provide accurate records of all vehicle construction activities; and

(2) Address how the construction and operation of the vehicles fulfills the contract specifications.

(b) After reviewing the report required under paragraph (a) of this section, and visually inspecting and road testing the delivered vehicles, the vehicles meet the contract specifications.

(c) For procurements of:

(1) Ten or fewer buses; or

(2) Procurements of twenty vehicles or fewer serving rural (other than urbanized) areas, or urbanized areas of 200,000 people or fewer; or

(3) Any number of primary manufacturer standard production and unmodified vans, after visually inspecting and road testing the vehicles, the vehicles meet the contract specifications.

[56 FR 48395, Sept. 24, 1991, as amended at 71 FR 14118, Mar. 21, 2006]

§ 663.39 Post-delivery audit review.

(a) If a recipient cannot complete a post-delivery audit because the recipient or its agent cannot certify Buy America compliance or that the rolling stock meets the purchaser's requirements specified in the contract, the rolling stock may be rejected and final acceptance by the recipient will not be required. The recipient may exercise any legal rights it has under the contract or at law.

(b) This provision does not preclude the recipient and manufacturer from agreeing to a conditional acceptance of rolling stock pending manufacturer's correction of deviations within a reasonable period of time.

Subpart D—Certification of Compliance with or Inapplicability of Federal Motor Vehicle Safety Standards

§ 663.41 Certification of compliance with Federal motor vehicle safety standards.

If a vehicle purchased under this part is subject to the Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in part 571 of this title, a recipient shall keep on file its certification that it received, both at the pre-award and post-delivery stage, a copy of the manufacturer's self-certification information that the vehicle complies with relevant Federal Motor Vehicle Safety Standards.

§ 663.43 Certification that Federal motor vehicle standards do not apply.

(a) Except for rolling stock subject to paragraph (b) of this section, if a vehicle purchased under this part is not subject to the Federal Motor Vehicle Safety Standards issued by the National Highway Traffic Safety Administration in part 571 of this title, the recipient shall keep on file its certification that it received a statement to that effect from the manufacturer.

(b) This subpart shall not apply to rolling stock that is not a motor vehicle.

APPENDIX C

FEDERAL MINIMUM WAGE RATES

PREVAILING WAGE INSTRUCTIONS FOR THE CONTRACTOR & SUBCONTRACTOR

The contractor shall electronically submit completed copies of certified payroll records to the Commissioner of Labor & Industry, Prevailing Wage Unit by going on-line to www.dllr.state.md.us/prevwage and following the instructions for submitting payroll information (NOTE: A contractor must register prior to submitting on-line certified payroll information).

If you have technical questions regarding electronic submittal, contact the Department at prevailingwage@dllr.state.md.us.

All certified payroll records shall have an accurate week beginning and ending date. The contractor shall be responsible for certifying and submitting to the Commissioner of Labor and Industry, Prevailing Wage Unit all of their subcontractors' payroll records covering work performed directly at the work site. By certifying the payroll records, the contractor is attesting to the fact that the wage rates contained in the payroll records are not less than those established by the Commissioner as set forth in the contract, the classification set forth for each worker or apprentice conforms with the work performed, and the contractor or subcontractor has complied with the provisions of the law.

A contractor or subcontractor may make deductions that are (1) required by law; (2) required by a collective bargaining agreement between a bona fide labor organization and the contractor or subcontractor; or (3) contained in a written agreement between an employee and an employer undertaken at the beginning of employment, if the agreement is submitted by the employer to the public body awarding the public work and is approved by the public body as fair and reasonable.

A contractor or subcontractor is required to submit information on-line on their fringe benefit packages including a list of fringe benefits for each craft employed by the contractor or subcontractor, by benefit and hourly amount. Where fringe benefits are paid in cash to the employee or to an approved plan, fund, or program, the contribution is required to be indicated.

Payroll records must be electronically submitted and received within 14 calendar days after the end of each payroll period. If the contractor is delinquent in submitting payroll records, processing of partial payment estimates may be held in abeyance pending receipt of the records. In addition, if the contractor is delinquent in submitting the payroll records, the contractor shall be liable to the contracting public body for liquidated damages. The liquidated damages are $10.00 for each calendar day the records are late.

Only apprentices registered with the Maryland Apprenticeship and Training Council shall be employed on prevailing wage projects. Apprentices shall be paid a percentage of the determined journey person 's wage for the specific craft.

Overtime rates shall be paid by the contractor and any subcontractors under its contracts and agreements with their employees which in no event shall be less than time and one-half the prevailing hourly rate of wages for all hours worked in excess of ten (10) hours in any one calendar day; in excess of forty (40) hours per workweek; and work performed on Sundays and legal holidays.

Contractors and subcontractors employing a classification of worker for which a wage rate was not issued SHALL notify the Commissioner of Labor & Industry, Prevailing Wage Unit, for the purpose of obtaining the wage rate for said classification PRIOR TO BEING EMPLOYED on the project. To obtain a prevailing wage rate which was NOT listed on the Wage Determination, a contractor or subcontractor can look on the DLLR webpage under prevailing wage.

Contractors and subcontractors shall maintain a valid copy of proper State and county licenses that permit the contractor and a subcontractor to perform construction work in the State of Maryland. These licenses must be retained at the worksite and available for review upon request by the Commissioner of Labor and Industry's designee.

PREVAILING WAGE INSTRUCTIONS FOR THE CONTRACTORAND SUBCONTRACTOR [con't]

Under the Maryland Apprenticeship and Training Council requirements, consistent with proper supervision, training and continuity of employment and applicable provisions in collective bargaining agreements, a ratio of one journey person regularly employed to one apprentice shall be allowed. No deviation from this ratio shall be permitted without prior written approval from the Maryland Apprenticeship and Training Council.

Laborers may NOT assist mechanics in the performance of the mechanic's work, NOR USE TOOLS peculiar to established trades.

ALL contractors and subcontractors shall employ only competent workers and apprentices and may NOT employ any individual classified as a HELPER or TRAINEE on a prevailing wage project.

In 2009, the State Apprenticeship and Training Fund law was enacted, and the Department is in the process of implementation. See §17-601-17-606, State Finance and Procurement Article, Annotated Code of Maryland. There is no obligation to make contributions under this law at this time. However, the Department anticipates that obligations under this law will be required beginning in the spring of 2013. You will receive notice prior to when the obligations will become due.

Once implemented, this law will require that contractors and certain subcontractors performing work on certain public work contracts are required to make contributions toward apprenticeship. Contractors and subcontractors will have three options where they can choose to make their contributions: (1) participate in a registered apprenticeship training program; (2) contribute to an organization that has a registered apprenticeship training program; or (3) contribute to the State Apprenticeship and Training Fund.

For additional information, contact:
Division of Labor and Industry
Maryland Apprenticeship and Traning
1100 North Eutaw Street, Room 606
Baltimore, Maryland 21201
(410) 767-2246
E-Mail Address: matp@dllr.state.md.us

STATE OF MARYLAND

DEPARTMENT OF LABOR, LICENSING AND REGULATION
DIVISION OF LABOR AND INDUSTRY
PREVAILING WAGE SECTION
1100 N. Eutaw Street, Room 607
Baltimore, MD 21201
(410) 767-2342

The wage rates to be paid laborers and mechanics for the locality described below is announced by order of Commissioner of Labor and Industry.

It is mandatory upon the successful bidder and any subcontractor under him, to pay not less than the specific rates to all workers employed by them in executing contracts in this locality. Reference: Annotated Code of Maryland State Finance and Procurement, Section 17-201 thru 17-226.

These wage rates were taken from the locality survey of 2012 for Baltimore City, issued pursuant to the Commissioner's authority under State Finance and Procurement Article Section 17-209, Annotated Code of Maryland or subsequent modification.

**Note: If additional Prevailing Wage Rates are needed for this project beyond those listed below, contact the Prevailing Wage Unit. Phone: (410) 767-2342, email: prevailingwage@dllr.state.md.us.

Name and Title of Requesting Officer: Joseph Johnson,

Department, Agency or Bureau: Maryland Transit Administration

6 Saint Paul Street Baltimore, MD 21202

Project Number
T-0451-0240

Determination Number
17289

Location and Description of work:
Baltimore City: MTA is going to add route pushbuttons that will be controlled by a redundant non-vital PLC. To further enhance safety, train detection in the yard ladder tracks is also being added utilizing wheel detectors to prevent the possibility of any switch being thrown under a train.

Date of Issue: Aug 28, 2013

BUILDING CONSTRUCTION

CLASSIFICATION	MODIFICATION REASON	BASIC HOURLY RATE	BORROWED FROM	FRINGE BENEFIT PAYMENT
BALANCING TECHNICIAN	SR	27.16		$12.58
BOILERMAKER	AD	37.11		$21.87
BRICKLAYER	AD	27.21		$8.30
CARPENTER	AD	24.84		$12.02
CARPET LAYER	AD	26.61	031	$7.64
CEMENT MASON	AD	23.60		$8.98
COMMUNICATION INSTALLER TECHNICIAN	AD	24.63		$11.97 a + b
DRYWALL - SPACKLING, TAPING, & FINISHING	AD	24.14		$8.97
ELECTRICIAN	AD	34.60		$16.01
ELEVATOR MECHANIC	AD	40.80		$27.28
FIRESTOPPER	AD	26.06	005	$7.66

GLAZIER	AD	26.88		$17.24	
INSULATION WORKER	AD	33.13	005	$15.21	
IRONWORKER - FENCE ERECTOR	AD	26.88		$17.24	
IRONWORKER - ORNAMENTAL	AD	29.55	003	$15.33	
IRONWORKER - REINFORCING	AD	26.38	005	$16.94	
IRONWORKER - STRUCTURAL	AD	26.88		$17.24	
LABORER - AIR TOOL OPERATOR	AD	16.18		$5.49	
LABORER - BLASTER - DYNAMITE	AD	16.18		$5.49	
LABORER - BURNER	AD	16.18		$5.49	
LABORER - CLEANER (JANITORIAL)	AD	18.56	001	$15.05	
LABORER - COMMON OR UNSKILLED	AD	15.61		$4.57	
LABORER - CONCRETE PUDDLER	AD	16.18		$5.49	
LABORER - CONCRETE SURFACER	AD	16.18		$5.49	
LABORER - CONCRETE TENDER	AD	16.18		$5.49	
LABORER - CONCRETE VIBRATOR	AD	16.18		$5.49	
LABORER - DENSITY GAUGE	AD	16.18		$5.49	
LABORER - GRADE CHECKER	AD	16.18		$5.49	
LABORER - HAND ROLLER	AD	16.18		$5.49	
LABORER - HAZARDOUS MATERIAL HANDLER	AD	16.18		$5.49	
LABORER - JACKHAMMER	AD	16.18		$5.49	
LABORER - LANDSCAPING	AD	18.56	001	$15.05	
LABORER - LAYOUT	AD	16.18		$5.49	
LABORER - MASON TENDER	AD	16.18		$5.49	
LABORER - MORTAR MIXER	AD	16.18		$5.49	
LABORER - PIPELAYER	AD	16.18		$5.49	
LABORER - PLASTERER - HANDLER	AD	16.18		$5.49	
LABORER - SCAFFOLD BUILDER	AD	16.18		$5.49	
LABORER - TAMPER	AD	16.18		$5.49	
MILLWRIGHT	AD	27.96		$12.30	
PAINTER	AD	24.14		$8.97	
PILEDRIVER	AD	25.77		$8.08	
PLUMBER	AD	36.35		$16.42	
POWER EQUIPMENT OPERATOR - ASPHALT DISTRIBUTOR	AD	23.78	033	$6.87	
POWER EQUIPMENT OPERATOR - BACKHOE	AD	25.03	005	$14.85	
POWER EQUIPMENT OPERATOR - BOBCAT	AD	22.34		$11.55	a + b
POWER EQUIPMENT OPERATOR - BOOM TRUCK	AD	33.10	031	$9.70	
POWER EQUIPMENT OPERATOR - BROOM TRUCK	AD	23.78	033	$6.87	
POWER EQUIPMENT OPERATOR - BULLDOZER	AD	25.75		$11.80	a + b
POWER EQUIPMENT OPERATOR - CONCRETE PUMP	AD	32.50	031	$2.64	
POWER EQUIPMENT OPERATOR - CRANE	AD	31.04		$15.05	
POWER EQUIPMENT OPERATOR - CRANE - TOWER	AD	29.84	005	$14.85	a
POWER EQUIPMENT OPERATOR - DRILL - RIG	AD	32.05	031	$8.85	
POWER EQUIPMENT OPERATOR - DRILLER	AD	29.30	003	$15.05	
POWER EQUIPMENT OPERATOR - EXCAVATOR	AD	25.75		$11.80	a + b
POWER EQUIPMENT OPERATOR - FORKLIFT	AD	25.03	005	$14.85	a
POWER EQUIPMENT OPERATOR - GRADALL	AD	26.75		$11.80	
POWER EQUIPMENT OPERATOR - GRADER	AD	25.03	005	$14.85	a
POWER EQUIPMENT OPERATOR - GUARD RAIL POST DRIVER	AD	25.75	005	$11.80	
POWER EQUIPMENT OPERATOR - LOADER	AD	25.75		$11.80	a + b
POWER EQUIPMENT OPERATOR - MASTER MECHANIC	AD	30.34	005	$14.97	
POWER EQUIPMENT OPERATOR - MECHANIC	AD	25.03	005	$14.85	
POWER EQUIPMENT OPERATOR - MILLING MACHINE	AD	25.92	001	$13.35	
POWER EQUIPMENT OPERATOR - OILER	AD	23.55	005	$17.30	a
POWER EQUIPMENT OPERATOR - PAVER	AD	26.47	001	$13.35	
POWER EQUIPMENT OPERATOR - ROCK / STUMP TUB GRINDER	AD	25.75	005	$11.80	
POWER EQUIPMENT OPERATOR - ROLLER - ASPHALT	AD	26.47	001	$13.35	

POWER EQUIPMENT OPERATOR - ROLLER - EARTH	AD	25.75	005	$11.80	a
POWER EQUIPMENT OPERATOR - SCREED	AD	25.75	005	$11.80	
POWER EQUIPMENT OPERATOR - SWEEPER	AD	25.03	005	$14.85	
POWER EQUIPMENT OPERATOR - TRENCHER	AD	25.75	005	$11.80	
RESILIENT FLOOR	AD	25.00	013	$6.00	
ROOFER/WATERPROOFER	AD	25.00		$7.67	
SHEETMETAL WORKER	AD	38.39		$14.68	
SPRINKLERFITTER	AD	30.48		$17.02	
STEAMFITTER/PIPEFITTER	AD	36.35		$16.42	
TILE & TERRAZZO FINISHER	AD	20.48		$8.84	
TILE & TERRAZZO MECHANIC	AD	25.29		$9.99	
TRUCK DRIVER - DUMP	AD	22.00	045	$0.00	
TRUCK DRIVER - TRACTOR TRAILER	AD	34.42	031	$9.70	

FRINGE REFERENCES AS NOTED:

a. PAID HOLIDAYS: New Year Day, Memorial Day, July 4th, Labor Day, Thanksgiving Day & Christmas Day.

b. PAID VACATIONS: Employees with 1 year service - 1 week paid vacation;
2 years service - 2 weeks paid vacation;
10 years service - 3 weeks paid vacation.

c. PAID HOLIDAYS: New Year Day, Memorial Day, July 4th, Labor Day, Veteran's Day, Thanksgiving Day & Christmas Day.

Modification Codes

(AD) 17-209 Annual Determination from Survey Wage Data Received
(CH) 17-211 Commissioners' Hearing
(CR) 17-208 Commissioners' Review
(SR) 17-208 Survey Review by Staff

Each "Borrowed From" county is identified with the FIPS 3-digit county code unique for the specific jurisdiction in Maryland.

For additional information on the FIPS (Federal Information Processing Standard) code, see http://www.census.gov/datamap/fipslist/AllSt.txt

The Prevailing Wage rates appearing on this form were originally derived from Maryland's annual Wage Survey. The Commissioner of Labor & Industry encourages all contractors and interested groups to participate in the voluntary Wage Survey, detailing wage rates paid to workers on various types of construction throughout Maryland.

A mail list of both street and email addresses is maintained by the Prevailing Wage Unit to enable up-to-date prevailing wage information, including Wage Survey notices to be sent to contractors and other interested parties. If you would like to be included in the mailing list, please forward (1) your Name, (2) the name of your company (if applicable), (3) your complete postal mailing address, (4) your email address and (5) your telephone number to PWMAILINGLIST@dllr.state.md.us. Requests for inclusion can also be mailed to: Prevailing Wage, 1100 N. Eutaw Street - Room 607, Baltimore MD 21201-2201.

APPENDIX E

LIGHT RAIL CLEARANCE REQUIREMENTS

CHAPTER 4

TRACK ALIGNMENT AND VEHICLE CLEARANCE

CHAPTER 4
TRACK ALIGNMENT AND VEHICLE CLEARANCE

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CHAPTER 4

TRACK ALIGNMENT AND VEHICLE CLEARANCE

4.7. GENERAL

The criteria for the alignment of the Central Light Rail Line as set forth in this Chapter, has been established to provide optimum safety, passenger comfort, and reduced maintenance, by utilizing accepted engineering practice, and the experiences of other transit and railroad systems presently in operation.

In general, the track alignment shall be designed to accommodate speeds of up to fifty-five miles per hour. However, physical constraints along various portions of the system, together with other design limitations may preclude this capability.

Stationing and geometrics shall generally be denoted for the centerline of the outbound track. Independent stationing and geometrics for each track will be required in certain cases such as when tracks are not parallel, and where parallel tracks have independent profiles.

The Central Light Rail Line includes portions where the LRV's will operate in joint usage with railroad freight traffic. The applicable minimum geometric design criteria for each railroad system will be met in the design of the tracks. Criteria for these railroads are detailed in Section 4.3 of this Chapter.

Correlation between horizontal and vertical alignment should avoid a combination of minimum radius, maximum grade, and maximum unbalanced superelevation.

4.2. TRACK ALIGNMENT AND CLEARANCES

4.2.1 Horizontal Ali nment

(1) The alignment shall be composed of tangents, circular curves, and spiral transitions.

Superelevation shall be used to maximize running speeds where it does not interfere with street grading on shared right-of-way.

(2) The minimum desirable length, in feet, of tangent track between curves, that are not part of a turnout or ladder track shall be equal to three times the design speed in miles per hour, or a minimum of 50 feet for joint use tracks and 30 feet for exclusive light rail tracks.

For curves in the same direction, a series of compound curves is a preferred arrangement to a broken back curve.

A. minimum tangent distance of 45' is preferred at each end of the station platform. If such distance is not obtainable, the midordinate and the end overhang clearances for the design vehicle shall be checked for high platform condition.

All turnouts shall preferably be located on tangents.

(3) Circular curves shall be defined by the arc definition and specified by their degree of curvature and radii as determined by the following formula:

$$D = \frac{57}{R}$$

Where R = radius in feet
D = degree of curvature

The minimum radii for mainline tracks shall be:
Off-street 300' minimum

The minimum radii for service tracks shall be:
100' minimum
82' absolute minimum

The minimum length of a circular curve shall be equal to three (3) times the design speed in miles per hour, with the exception of alignment in the Central Business District (CBD). When a circular curve has spirals at each end, the length in fee: of that curve added to the sum of one half the lengths of bo:h spirals shall be equal to or greater than three times the design speed in miles per hour.

(4) Spiral transition curves shall be used on all mainline horizontal curves with a degree of curvature greater than 0.5 degrees, in order to ease the horizontal transition of the vehicle and to develop the super-elevation of the track. Spiral curves shall be defined by Hickerson formula. In CBD where the design speed is 25 MPH or less, spirals shall be provided for curves of radii less than 1,600 feet.

The minimum length of a spiral shall be the greater of the lengths determined from the following formulae (rounded off to the nearest 10'), but preferably not less than 60':

Ls (Minimum) = 31 E
Ls (Minimum) = 0.61 UV
Ls (Minimum) = 1.03 EV

Where: Ls = Spiral length in feet E = Actual superelevation in inches U= Unbalanced superelevation in inches (the unbalance being the difference between equilibrium superelevation and the superelevation actually being used).

V = Curve design speed in miles per hour.

Where geometric conditions warrant, a spiral may be reduced to the absolute minirr:um of 30'.

A spiral is preferred, but not required for design speeds that are less than 10 miles per hour. Table 4.1 indicates the radii in feet for the curve, the design speed and corresponding superelevation to be used.

Where compound curves are used, they shall be connected by an adequate spiral transition curve. The minimum spiral length shall be the greater of the lengths as determined by the following:

L = 31 (E2 - E1)
L = 0.61 (U2 - U1)V
L = 1.03 (E2 - E1)V

Where:
L = Minimum length of spiral, in feet
E1 = Actual superelevation of the first circular curve, in inches
E2 = Actual superelevation of the second circular curve, in inches
U1 = Unbalanced superelevation of the first circular curve, in inches
U2 = Unbalanced superelevation of the second circular curve, in inches.
V = Design speed through the circular curves, in mph

Spiral transition curves for compound curves will not be used when both (E2 -E1) and (U2 - U1) are less than one inch.

(5) Top of inside rail in a curve shall be set at profile line and shall be referenced as profile rail. Yard and service tracks shall not be superelevated.

The equilibrium superelevation is the sum of the actual superelevation and the unbalance. The maximum values of these shall be:

E (absolute maximum)* = 6"
E (desirable maximum) = 4"
U (absolute maximum) = 4-1 /2u
* With prior approval of MTA

Superelevation shall be determined by either of the following formulae:

E + l! = 0.00069 V2 D

E+U=3.96 V2 R Where: V = design speed,
through the curve, in mph D =
degree of curve, in degrees R =
radius of curve, in feet

Values of actual superelevation (E) shall be rounded to the nearest one-quarter inch (1 /4"). For a total superelevation (E + U) of 1" or less, no actual super6levation (E) need be provided.

Unbalanced superelevation (U) shall vary from 0" to 4" maximum in the following manner:

In mixed traffic, E shall equal zero (0) until U = 4" is reached. At this point, a limit shall be placed on the design speed or E may be increased until E + U is equal to 10-1 /2". When E + U exceeds 10-1 /2", a limit shall be placed on the design speed.

In areas of exclusive use, E shall be calculated by using the formula E = 2.77 V2/R which introduces a combination of actual superelevation with unbalanced superelevation. This equation shall be used until a calculated value of E-6" is reached. Note that 3" of unbalance is already considered in this calculation.

Superelevation for a circular curve used without spirals shall be developed along the tangent immediately preceding the Point of Curvature (P.C.), and shall be run out in the tangent immediately beyond the Point of Tangency (P.T.). The transition length is then determined from the minimum spiral length formulae of this subsection. For compound circular curves without a spiral, the change in superelevation shall be run out entirely within the curve of the larger radius.

Use Table 4.1 for values of actual superelevation to be provided in alignment calculations.

4.2.2. Vertical Alignment

(1) Vertical curves shall be defined by parabolic curves having a constant rate of grade change.

(2) The minimum desirable length of vertical tangent shall be 100'. The track at a station shall preferably be on a tangent grade that extends 45' beyond each end of the platform. The absolute minimum tangent distance shall be 35' with exception in CBD area. Special trackwork shall be located on tangent grades. In CBD, the stringent conditions of existing street grades, intersecting streets and top of rail close to pavement make this economically unfeasible and,

therefore, the above requirement shall be exempted.

(3) The following profile grade limitations shall apply:

Mainline tracks	
Maximum (long sustained grade)	4%
Maximum (short sustained grade of up to 2500' between PVIs of vertical curves)	69'0
Maximum (short sustained grade of up to 500' between PVIs of vertical curves)	9%
Station Area	
Maximum	2.5%
Desirable	0.5%
Storage Tracks	0%

(4) The lengths of vertical curves shall be determined as follows:

Desirable length	L = 200 (G1 - G2)
Preferred minimum length	L = 100 (G1 - G2)
Absolute minimum	
crest curves	L = V2 (G1 - G2) / 25
sag curves	L = V2 (G1 - G2) / 45

Where:
L = Length of vertical curve, in feet

(G1 - G2)= Algebraic difference in gradients connected by the vertical curve, in percent.

V = Design speed in mph

Increase in length of vertical curves to compensate for combined horizontal and vertical curvature is not required.

Vertical curves shall be provided for all grade intersections where the algebraic difference in grades is more than 0.596

The minimum length of vertical curves shall be 65 feet or three times the design speed in miles per hour, whichever is greater, except in CBD area, where cross street intersection may dictate otherwise.

Where a profile tangent between vertical curves is shorter than 35 feet, consideration should be given to reverse or compound curves, since that would then become the more preferable alignment.

The minimum equivalent radius of curvature of any vertical curve shall not be less than 750 feet when located on primary tangent track. This equivalent radius of curvature can be calculated from the following formula:

$$R = \frac{L}{.01x(g2 - g1)}$$

R = Minimum radius of curvature of a vertical curve in feet.

L = Length of vertical curve in feet

g1 = Percent grade of approaching tangent g2
= Percent grade of departing tangent.

4.2.3. Track S12acina

The minimum allowable spacing for two light rail centerlines of mainline tracks, with no catenary support installation between these tracks, and with equal superelevation values not exceeding four inches, shall be determined from the following formula:

D =Tt+Ta+CMT

Where:

D = Minimum allowable spacing between track centerlines in feet.

Tt = Dynamic half width of vehicle towards curve center, in feet (see Table 4.3)
Ta = Dynamic half width of vehicle away from curve center, in feet (see Tables 4.4A. wind 4.4B).
CMT= Construction and Maintenance Tolerances (see Section 4.2.4.4).

Based on the information furnished by the vehicle manufacturer, a reduction on the construction and maintenance tolerances may be considered within the CBD area. Since the train operation is at a lower speed, and the trackway is embedded construction; it is recommended that an absolute minimum track spacing of 12'-3" will be acceptable.

Where practical, secondary tracks shall be designed to meet the above criteria.

Along ballasted sections and where catenary poles are located between track centerlines, the minimum track spacing shall be determined from the following formula:

D = o t + Ta + (CM-0 2 + P (if applicable).

Where:

P = Diameter of catenary pole plus running clearances in feet.

4.2.4 Vehicle Clearance

(1) For light rail vehicle clearance diagrams refer to figures 4.1, 4.2 and 4.3.

(2) The Dynamic Outlines

Refer to figures 4.4 through 4.9.

Variations of the Dynamic Outline

Wher, a 4LRLV enters a horizontally curved track (including turnouts), the dynamic vehicle dimensions must be adjusted for end overhang and for middle ordinate shift. Furthermore, track superelevation must also be taken into consideration. Tables 4.3 through 4.5 show values Tt (Toward the Center of Curve), and Ta (Away from the Center of Curve), for the Dynamic Outline of the CLRLV under combinations of track curvatures and superelevations. For intermediate conditions, the designer may select the nearest combination which produces the larger dimension.

Figures 4.5 to 4.9 depict limits of the Dynamic Outline for the CLRLV in various sizes of standard turnouts. Intermediate values may be interpolated by the designer.

It is emphasized that the applicability of curved or superelevated track alignment dimensions for Tt and Ta is not conned to locations **where the track alignment** is curved, or in superelevation transition. Clearances to structures should be checked for the maximum Dynamic Outline requirements 45 feet in either direction along the track. This may mean that even though a given structure is alongside tangent level track, the minimum clearance to that structure equals that required along a nearby curved or a superelevated track section. As used in this Section, the term structure refers to any existing or proposed object except where otherwise specked.

Where the track alignment is on spiral, the minimum clearance requirements shall be no less than that required by the degree of curvature occurring within 45 feet of the structure in either direction along that track. The designer is reminded that the dimensions Tt and Ta are not equal for tangent tracks which include portions of a superelevation transition.

(4) Horizontal Clearances and Tolerances

Any structure alongside the rail line must be clear of the dynamic outline discussed in Sub-Sections (2) and (3) by a distance equal to the sum of the applicable clearances and tolerances outlined below:

Running Clearance at Poles	6"
Running Clearance Along All Structure Other Than Poles	2"
Construction Tolerance Along Proposed Soldier Pile and Lagging Wall	6"
Construction Tolerance Along All Other Proposed Structures	2'"
Track Construction and Maintenance Tolerance for Direct Fixation	1 /2"
Track Construction and Maintenance Tolerance for Mainline, Ballasted Track	3"

Track Construction and Maintenance	
Tolerance for Secondary Tracks	3"
Acoustical Treatment Where Required	3"

The above dimensions are design values, the applicability of which depends on the type of track construction, as well as on the type of structure which the vehicle must clear. The following is a description of the applicability and rationale of these values.

a) Running Clearances

To provide clear passage for a vehicle which has moved to the extreme position within the Dynamic Outline, the minimum horizontal clearance to any structure, or part of a structure, shall always include a horizontal running clearance.

b) Construction Tolerances Along Proposed Structures

Where the facility adjacent to the trackway is a structure, or part of a structure, the minimum horizontal construction tolerance shall be provided on the assumption that the structure, or part thereof, may be misplaced during construction by a dimension of that magnitude. It is emphasized that the term "structure" as used in this subsection applies to any facility to be constructed alongside CLRL and above the top of rail.

c) Track Construction and Maintenance Tolerances

The combination of several factors such as track misalignment, wheel and track gauge tolerances, together with wheel and rail wear, create the need for this tolerance. It is evident that a ballasted track would demand a greater tolerance than either a direct fixation or an embedded track would require. Furthermore, a distinction is also made for a mainline track as opposed to a secondary track for safety reasons. In addition, this tolerance includes anticipation of some unintentional cross level variance between the rails due to construction inaccuracies or delay in maintenance.

d) Acoustical Treatment

The need for this allowance shall be investigated in cases where noise produced from CLRL operations may be found in excess of tolerable limits for a given area. An example of this may be where the rail line is very near residential buildings, hospitals or schools.

(5) The Design Envelope

When the applicable clearances and tolerances discussed in Section (4) are added to the Dynamic Outline dimensions (Ta and Tt), the resulting envelope will be referred to in this manual as the Design Envelope. All structures installed above the top of the nearest rail must be set either at, or beyond this Design Envelope as shown in Figure 4.4, with the following exclusions:

a) Passenger Stations and Stops

At passenger stations, the distance from the edge of the high platform to the centerline of the track shall be in accordance with Chapter 9, Stations/Stops, Section 9.2.3.

b) Retaining Walls

Where retaining walls are used, they shall comply with the

following: 1) Cut Sections

In those cases where a retaining wall along the Rail System is in cut section, the minimum clearance from the centerline of track tc. the near face of a retaining wall shall be no less than that required to clear the Design Envelope, and never less than 7'-1 ₙ(8'-6" for joint use).

2) Fill Sections

In fill section, the top of a retaining wall shall be at the same elevation as the top of the adjacent rail (the rail nearest to the wall), and the distance from the centerline of track to the near face of the retaining wall shall be a minimum of fi'-0".

c) Through Girder Bridges

The lateral distance from a centerline of track to the nearest point on a through girder bridge must be at least equal to or greater than that required to clear the Design Envelope. (6) Vertical Clearances to Structures

Since the rail system will be powered by overhead electrification, the following vertical clearances from the top of the high rail along any given section of track to the soffit of any overhead structure, within the horizontal limits of the Design Envelope shall be provided:

Location	Minimum Vertical Clearance
At Overhead Bridges	15'0° Preferred 14'3" Absolute

4.3 RAILROAD FREIGHT TRACK ALIGNMENT AND CLEARANCES

Railroad tracks to be relocated or in joint usage areas shall be designed in conformance to the requirements of AREA Manual for Railroad Engineering, except as specified herein.

4.3.1 Horizontal Alignment

The horizontal alignment for main branch line tracks shall consist of tangents, circular curves,and spiral transitions based on a preferred design speed of 55 mph. Lead tracks and industrial spurs do not require spiral transitions.

Curves adjacent to turnouts on tracks which diverge from the main track shall be designed for the maximum allowable speeds for turnouts.

Lead track and industrial spurs shall be designed for a minimum of 10 mph.

(1) For main tracks, the desirable tangent length between curves shall be 300', with an absolute minimum value of 100'. For lead tracks and industrial spurs, a minimum tangent distance of 50' shall be provided between curve points. All turnouts shall be located on tangents.

(2) Curves shall be defined by the arc definition and specified by their degree of curvature.

The desirable degree of curvature for main tracks shall be 3°, but shall not exceed 9°30'. The desirable maximum curvature for lead tracks and industrial spurs shall be 12° and 15°, respectively. In extreme cases, industrial spurs may be designed with sharper curves that match the existing values, or as authorized by the GAEC.

The minimum length of circular curves for mainline tracks shall be 100'.

As a practical limitation, circular curves for sidings shall not be provided when the intersection angles are less than 30 minutes.

(3) Spiral transition curves shall be used for mainline and branch line tracks only. Spirals shall be provided on all curves where the superelevation required for the design speed (55 mph) is one-half inch (1 /2") or more.

The minimum length of a spiral shall be determined from the following formulae (rounded off to the nearest 10'), but preferably not less than 100'. The formulae are applied to the joint use track. Otherwise, refer to AREA Manuals. The largest Ls shall be used in the design.

Ls (min) = 1.03 EV
Ls (min) = 0.61 UV
Ls (min) = 31 E

Where:
Ls = Spiral length in feet
E = Actual superelevation in inches
U = Unbalanced superelevation in inches
V Curve design speed in mph

(4) Superelevation shall be provided on mainline and branch line tracks only based on the following formula:

$$E = \frac{2.0V2}{R}$$

E = Actual superelevation (inches)
V = Curve design speed (mph)
R = Radius of Curve (feet)

Values of actual superelevation (E) shall be rounded to the nearest one-quarter (1 /4") and for calculated values of less than one-half inch (1 /2"), no actual superelevation (E) need be applied.

Under joint freight and LRT operating conditions, E shall be obtained from above formula, until the calculated value reaches 3". At this point, 3" of unbalanced condition is achieved. E can be further increased an additional 3" and U increased an additional 1-1/2" to achieve desired speed.

(5) Use Table 4.2 for values of actual superelevation to be provided for joint use track calculations.

4.3.2 Vertical Alignment

(1) The profile grade shall be defined as the elevation of the top of the low rail. Vertical curves shall be defined by parabolic curves having a constant rate of grade change.

(2) The desirable minimum length of vertical tangents shall be 300' with an absolute minimum value of 200'.

Turnouts shall be located on tangent grades only.

(3) On main tracks, the preferred maximum grade shall be 1 %. This value may only be exceeded in cases where existing longitudinal grade is steeper than 1 %.

For lead tracks and industrial spurs, the grades shall preferably be 0.2% or less, but in no case shall exceed 0.4%. Grade compensations are not required.

(4) Vertical curves shall be used for all grade intersections where the algebraic difference in grade is more than 0.5%.

(5) The lengths of vertical curves shall be determined as follows (rounded off to the next largest hundred feet);

Summits: $L = 250 (G1 - G2)$

Sags: $L = 500 (G1 - G2)$

Where: L = Length of vertical curve, feet

(G1 - G2) = Algebraic difference in grades connected by the vertical curve in percent.

If existing railroad vertical curve is below desirable length, a replacement of same length of vertical curve would be considered as acceptable.

4.3.3 Clearances

(1) Horizcntal Clearance

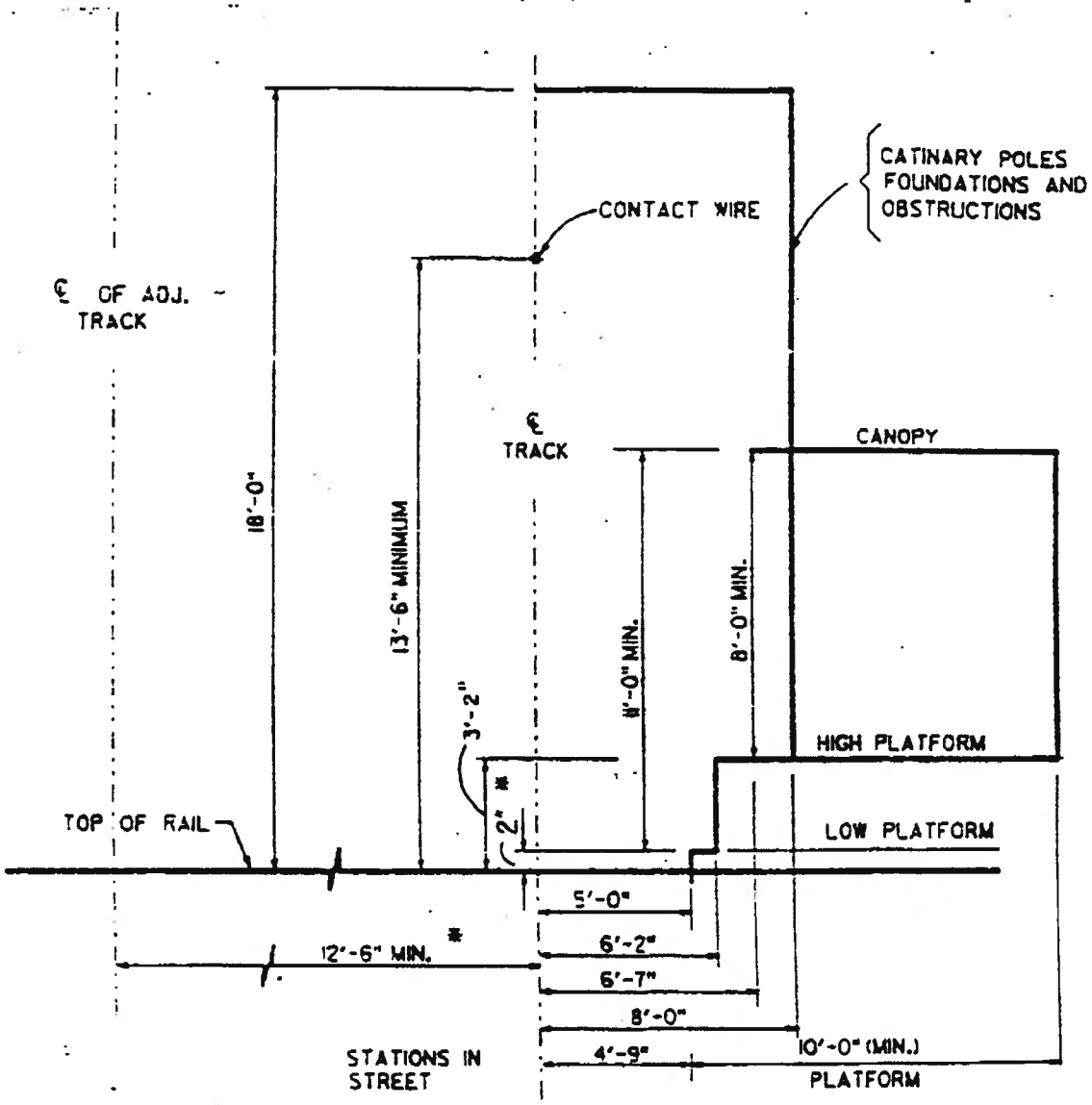
A.	Adjacent to centerline of R.R. Main Track	13'-0"* Pref. Min. 12'-6"* Abs. Min.
B.	Passenger Platforms	

	1. 4.1" to 4'-0" above top of rail (T/R)	6'-2"
	2. 1" to 4" above T/R	5'-0"
	3. 0" above T/R	4'-9"
C.	To an Obstruction	
	1. On Tangent	8'-6"
	2. On Curve	10'-0" Pref. Min. 8'-6"+"D"* Abs Min.
D.	To property line or curb face of adjacent street	12'-0" Pref. Min. 10'-0" Abs. Min.
E.	To curb face of adjacent parallel street at crossing gates	16'x"

Note: "D" denotes as degree of curve, (in terms of inches).

(2) Vertical Clearance Measured from Top of Rail — 22'-0" Pref. Min. / 18'-0" Abs. Min.

(3) For other information, see Clearance Diagrams on Fig. 4.1 and Fig. 4.2.



* EXCLUSIVE OF CBD AREA

MAIN LINE - TANGENT TRACK

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CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA LIGHT RAIL CLEARANCE DIAGRAM — FIGURE 4.1

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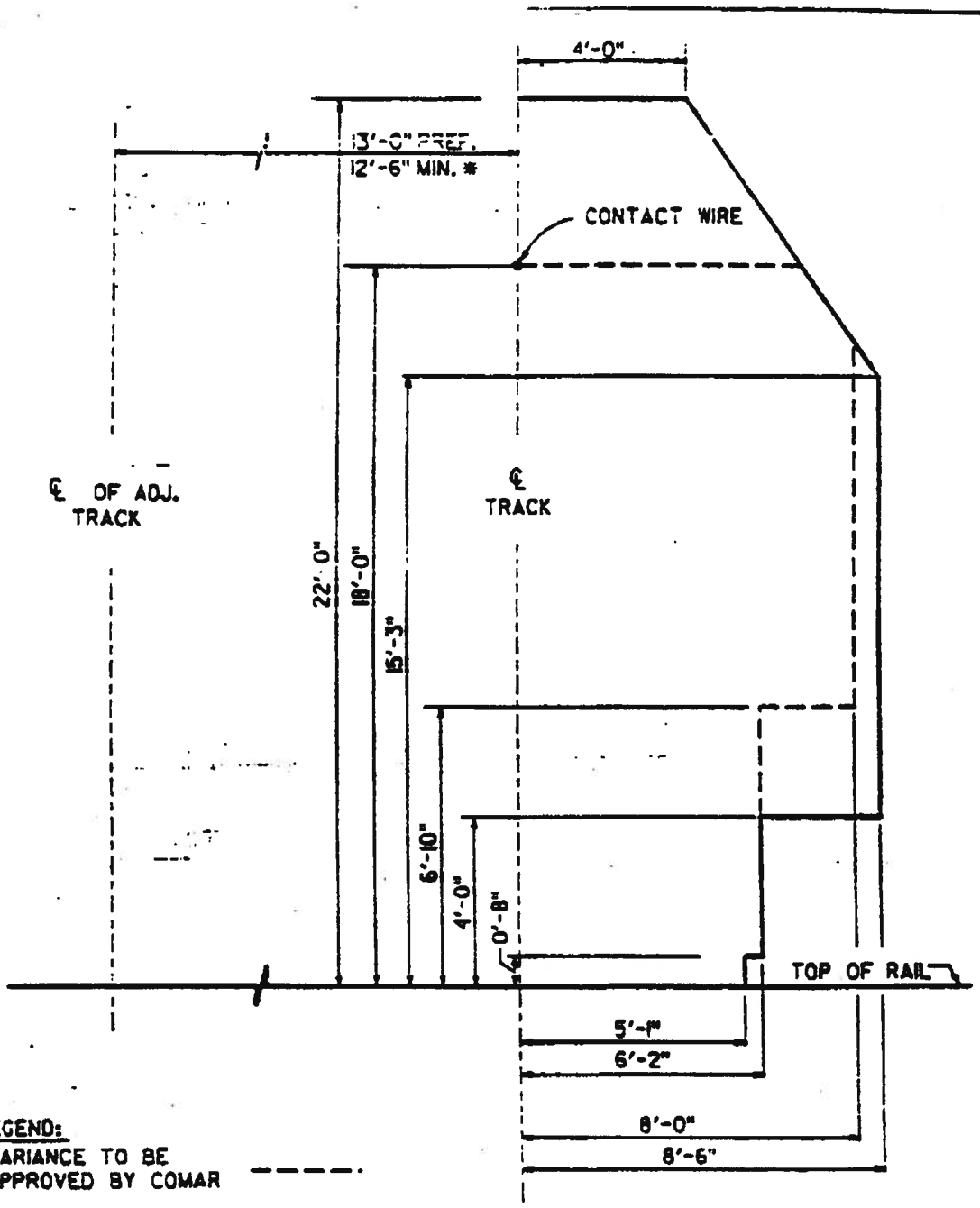

MAIN LINE - TANGENT TRACK

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION MASS TRANSIT ADMINISTRATION	PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC MORRISON - KNUDSEN ENGINEERS, INC CONSULTING ENGINEERS
CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA JOINT USE TRACKS FREIGHT CLEARANCE DIAG. FIGURE 4.2

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NOTES:

1. BASED ON COMPOSITE DYNAMIC OUTLINE FOR WORST CASE VEHICLE ON LEVEL TANGENT TRACK. THE LATERAL MOVEMENT FOR THE FOLLOWING ITEMS EQUALS TO APPROX. TEN INCHES.
   - MAXIMUM SUSPENSION DEFLECTION
   - TRANSVERSAL MOVEMENT OF CAR BODY, AXLE, WHEEL & RAIL
   - TRANSVERSAL CONSTRUCTION TOLERANCE OF CAR BODY AND TRUCK
   - MAXIMUM CAR BODY DEFLECTION
   - WHEEL WEAR
2. END OVERHANG (Ko) IS CRITICAL AT THIS POINT FOR RADIUS < 130'

DYNAMIC WIDTH OF VEHICLE ON CURVE

$$Ci = R - \left[\sqrt{R^2 - (L_1/2)^2 - (L_2/2)^2}\right] + B_1/2$$

$$Co = \left[\sqrt{(B_2/2 + C - D)^2 + (R - Ci + B_1/2)^2}\right] - R$$

$$Co = \left[\sqrt{(B_2/2 + C)^2 + (R - Ci + B - D)^2}\right] - R$$

VEHICLE ENVELOPE REQUIREMENTS

	NO MIRRORS	WITH MIRRORS
STATIC WIDTH OF VEHICLE (ft)	9.50	10.58
STATIC 1/2 WIDTH (ft)	4.75	5.29
DYNAMIC WIDTH (ft)	11.02	11.95
DYNAMIC 1/2 WIDTH (ft)	5.51	5.98
DYNAMIC EFFECT ON 1/2 WIDTH (ft)	0.76	0.68
DYNAMIC EFFECT ON 1/2 WIDTH (in)	9.12	8.16

HORIZONTAL THROW BETWEEN TRUCKS: Ci = 0450/R04 1/12 + 4.75

HORIZONTAL THROW OUTSIDE TRUCKS

WITHOUT MIRRORS: Co = (2836/R04 / 12 + 4.75

WITH MIRRORS: Co = (3745/R04 / 12 + 5.29

ADDITIONAL EFFECT OF VEHICLE DYNAMICS:

BETWEEN TRUCKS: X = 0.76 FEET

OUTSIDE TRUCKS WITHOUT MIRRORS: X = 0.76 FEET

OUTSIDE TRUCKS WITH MIRRORS: X = 0.68 FEET

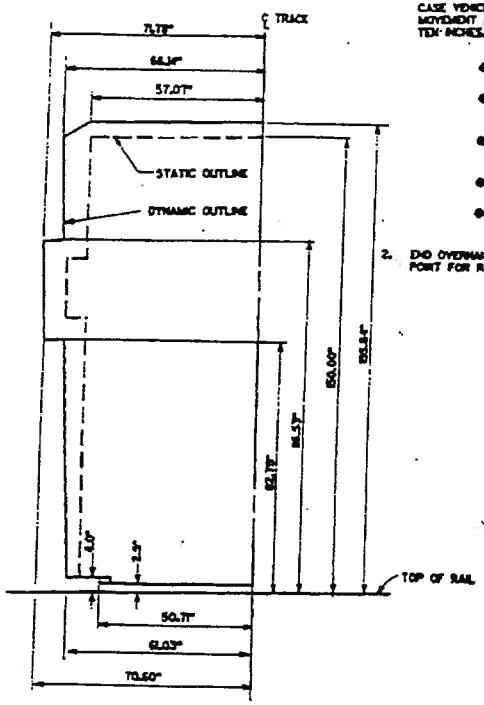
EFFECT OF SUPERELEVATION:	GUAGE	WORST CASE HEIGHT	FACTOR
BETWEEN TRUCKS	4.79	12.50	0.2074
OUTSIDE TRUCKS WITHOUT MIRRORS	4.79	0.33	0.0068
OUTSIDE TRUCKS WITH MIRRORS	4.79	9.71	0.1688

TOTAL ENVELOPE REQUIREMENTS (HALF WIDTH):

BETWEEN TRUCKS: T? = Ci + 0.76 + 0.22 + (Ea)

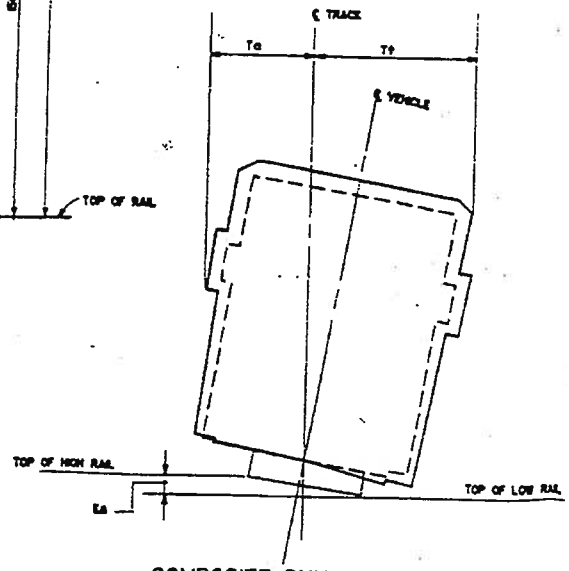
OUTSIDE TRUCKS WITHOUT MIRRORS: Ta = Co + 0.76 - 0.22 + (Ea)

OUTSIDE TRUCKS WITH MIRRORS: Ta = Co + 0.68 - 0.17 + (Ea)



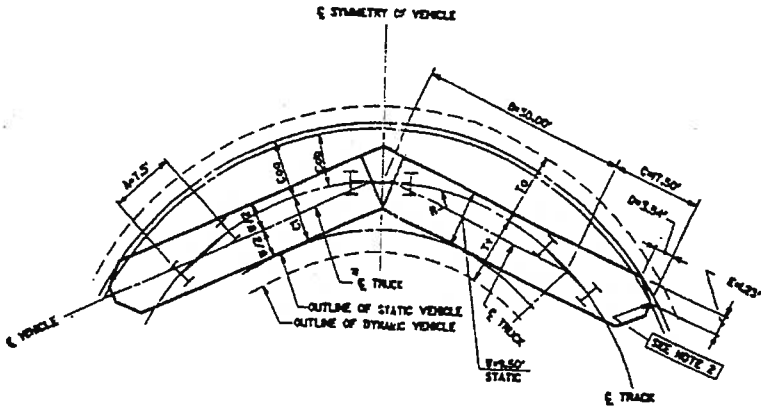
COMPOSITE DYNAMIC OUTLINE

LEVEL/TANGENT TRACK



COMPOSITE DYNAMIC OUTLINE

SUPERELEVATED / CURVED TRACK



PLAN GEOMETRY CURVES

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4-18

CENTRAL LIGHT RAIL LINE

2	GENERAL REVISIONS	KTK	11-29-94	
1	GENERAL REVISIONS	RDC	12-29-93	
NO.	DESCRIPTION	BY	DATE	

REVISIONS

DESIGNED: DATE 12-29-93

DRAWN: J.J.C.

CHECKED: APPROVED

APPROVED

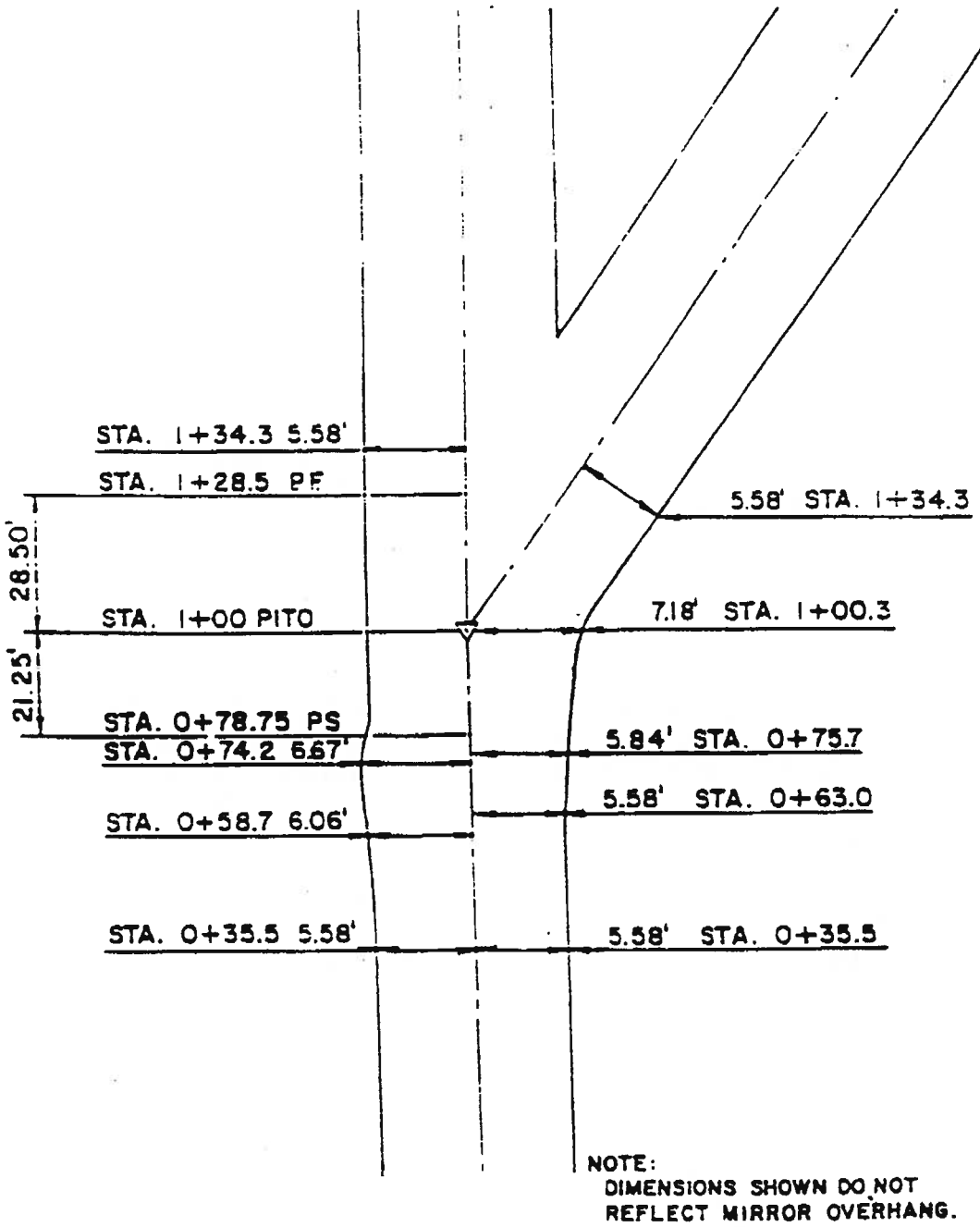
COMPOSITE DYNAMIC OUTLINE

SCALE: N.T.S.

CONTRACT NO. CLRL

DRAWING NO. DYNOUT

FIG. 4.4



NOTE:
DIMENSIONS SHOWN DO NOT REFLECT MIRROR OVERHANG.

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CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA DYNAMIC OUTLINE THROUGH #6 TURNOUT FIG. 4.5

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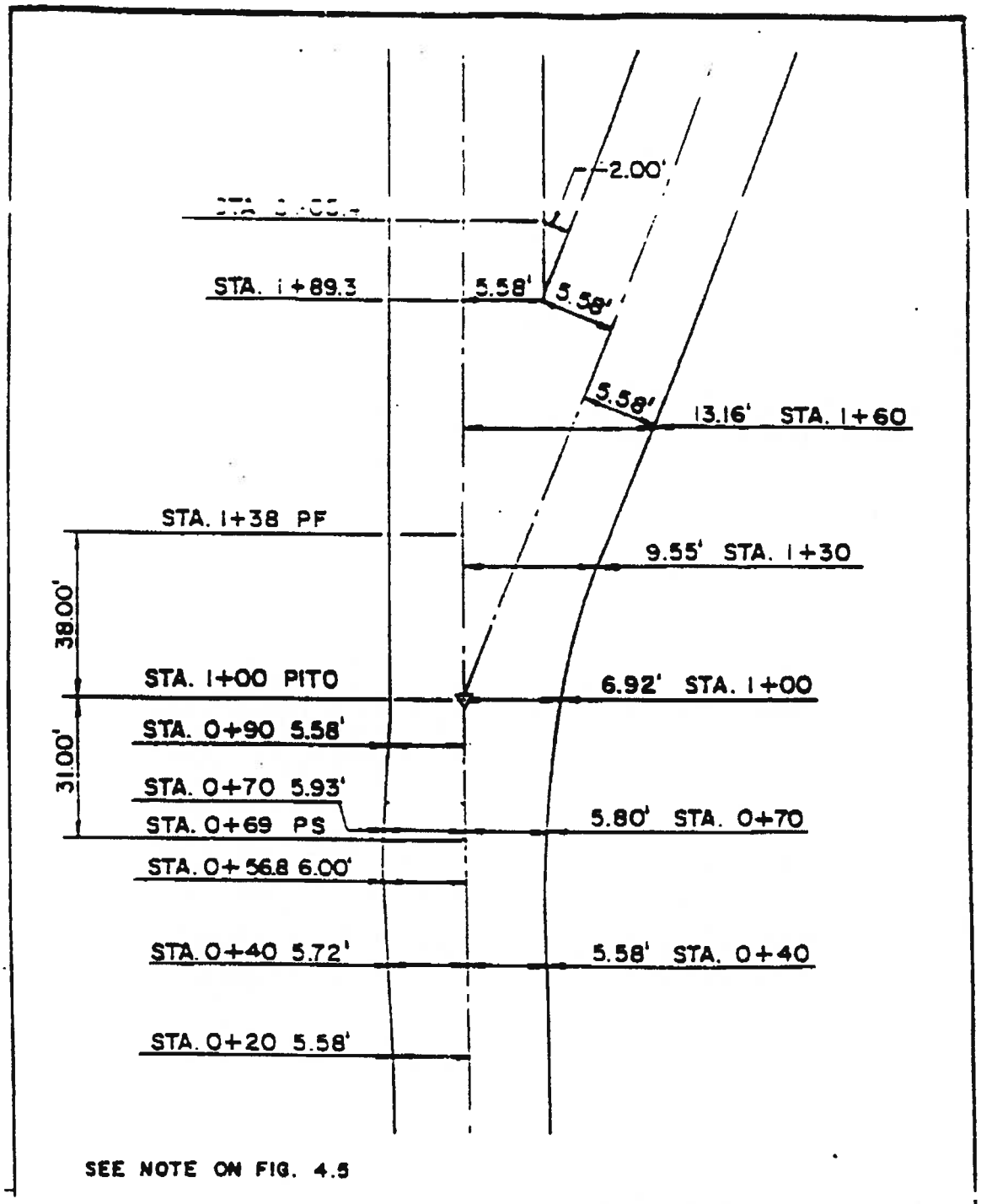

SEE NOTE ON FIG. 4.5

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION MASS TRANSIT ADMINISTRATION	PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC MORRISON - KNUDSEN ENGINEERS, INC CONSULTING ENGINEERS
CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA DYNAMIC OUTLINE THROUGH #3 TURNOUT FIG. 4.6

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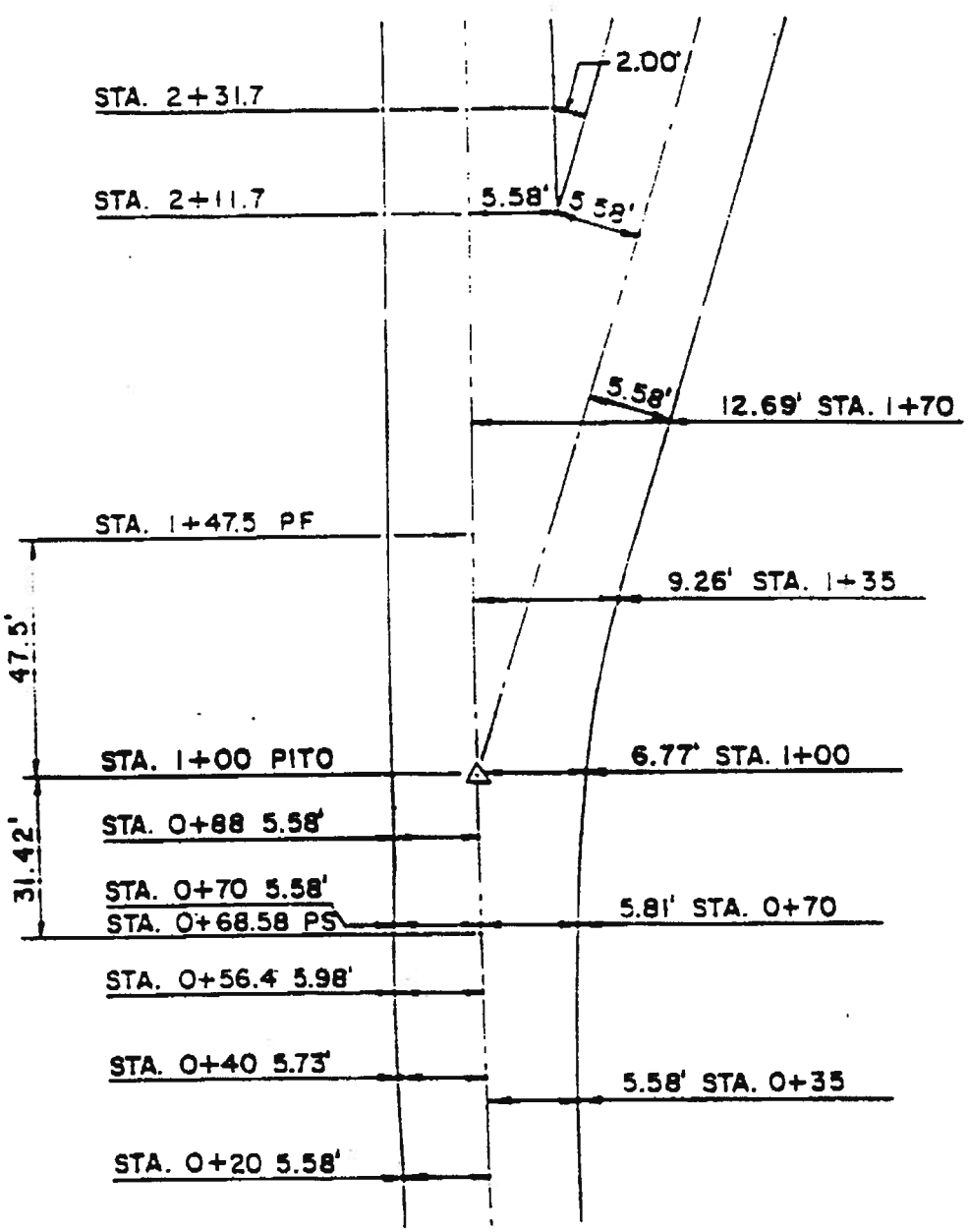

SEE NOTE ON FIG. 4.5

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION MASS TRANSIT ADMINISTRATION	PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC MORRISON - KNUDSEN ENGINEERS, INC CONSULTING ENGINEERS
CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA DYNAMIC OUTLINE THROUGH #10 TURNOUT FIG. 4.7

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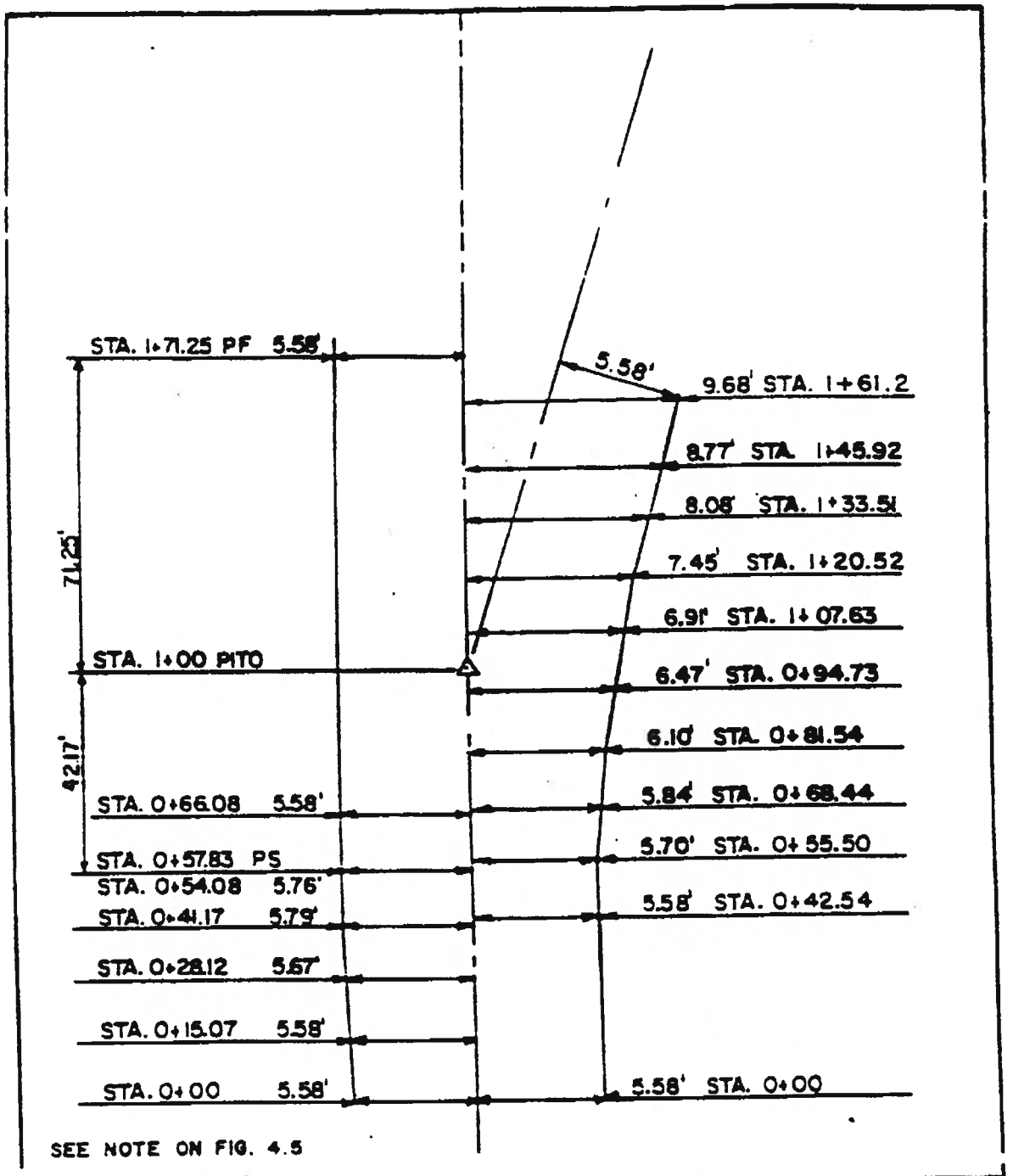

SEE NOTE ON FIG. 4.5

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION MASS TRANSIT ADMINISTRATION	PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC MORRISON - KNUDSEN ENGINEERS, INC CONSULTING ENGINEERS
CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA DYNAMIC OUTLINE THROUGH #15 TURNOUT FIG. 4.8

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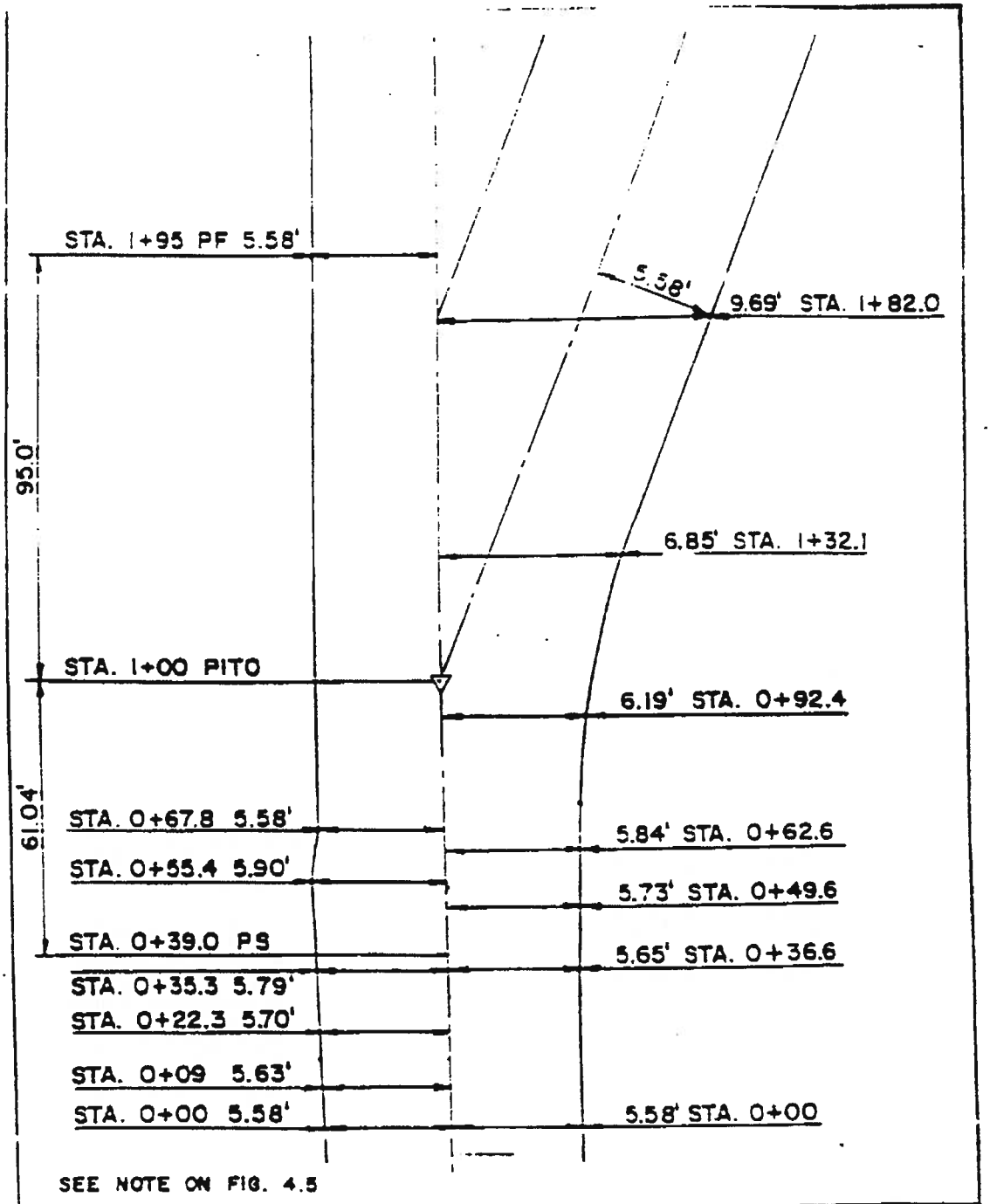

SEE NOTE ON FIG. 4.5

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CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA DYNAMIC OUTLINE THROUGH #20 TURNOUT FIG. 4.9

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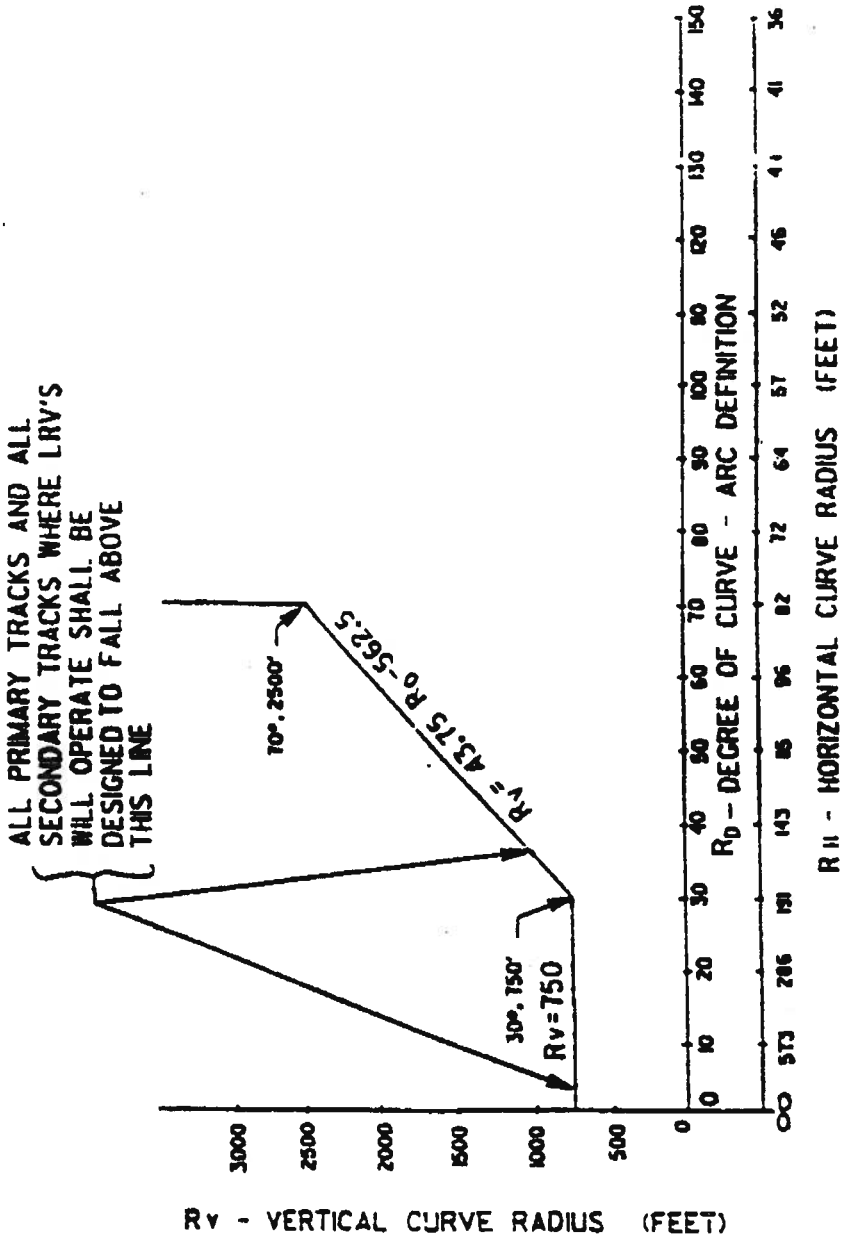

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CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA ALLOWABLE COMBINATIONS - SIMULTANEOUS HORIZONTAL & VERTICAL CURVES FIGURE 4.10

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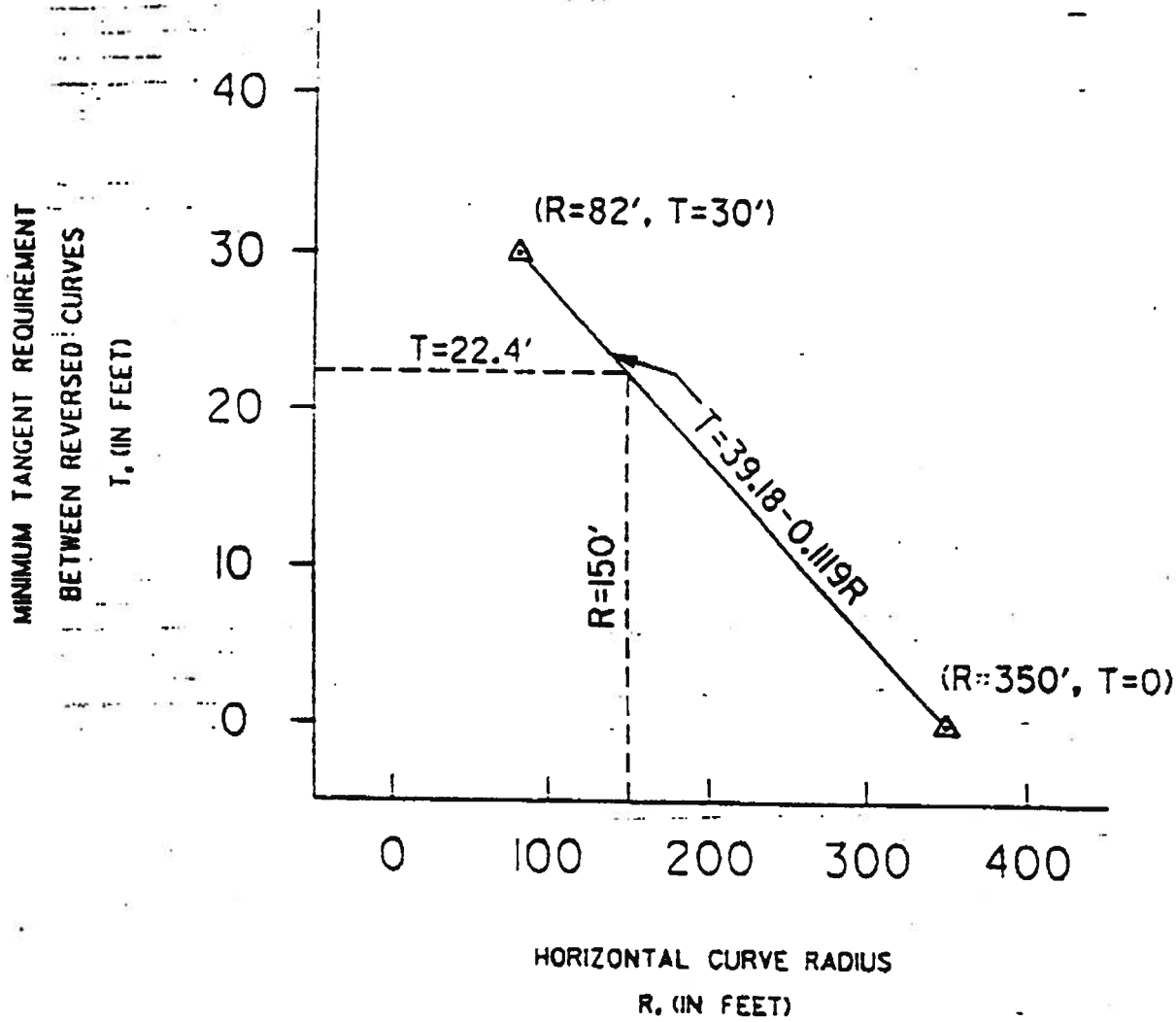

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CENTRAL LIGHT RAIL LINE	MANUAL OF DESIGN CRITERIA TANGENT REQUIREMENT FOR SHARP REVERSED CURVES FIGURE 4.11

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RADIUS of TRACK CENTERLINE	DESIGN SPEED MPH									
	10	15	20	25	30	35	40	45	50	55
20,000'	*	*	*	*	*	*	*	*	*	*
15,000'	*	*	*	*	*	*	*	*	*	*
10,000'	*	*	*	*	*	*	*	*	*	1/4"
7,500'	*	*	*	*	*	*	*	*	1"	1"
5,500'	*	*	*	*	*	*	1/4"	1"	1 1/4"	1 1/2"
5,000'	*	*	*	*	*	*	1"	1"	1 1/2"	1 3/4"
4,500'	*	*	*	*	*	1/4"	1"	1 1/4"	1 1/2"	1 3/4"
4,000'	*	*	*	*	*	1/4"	1"	1 1/2"	1 3/4"	2"
3,500'	*	*	*	*	—	1"	1 1/4"	1 1/2"	2"	2 1/2"
3,000'	*	*	*	*	1/4"	1 1/4"	1 1/2"	1 3/4"	2 1/4"	2 3/4"
2,500'	*	*	*	—	1"	1 1/4"	1 3/4"	2 1/4"	2 3/4"	3 1/4"
2,000'	*	*	*	1/4"	1 1/4"	1 3/4"	2 1/4"	2 3/4"	3 1/2"	4 1/4"
1,900'	*	*	—	1"	1 1/4"	1 3/4"	2 1/4"	3"	3 3/4"	4 1/2"
1,800	*	*	—	1"	1 1/2"	2"	2 1/2"	3"	3 3/4"	4 3/4"
1,700	*	*	—	1"	1 1/2"	2"	2 1/2"	3 1/4"	4"	5"
1,600	*	—	—	1"	1 1/2"	2"	2 3/4"	3 1/2"	4 1/4"	5 1/4"
1,500	*	*	—	1 1/4"	1 3/4"	2 1/4"	3"	3 3/4"	4 1/2"	5 1/2"
1,400	*	*	1/4"	1 1/4"	1 3/4"	2 1/2"	3 1/4"	4"	5"	6"
1,300	*	*	1/4"	1 1/4"	2"	2 1/2"	3 1/2"	4 1/4"	5 1/4"	R=331' MIN. RAD.
1,200	*	—	1"	1 1/2"	2"	2 3/4"	3 3/4"	4 3/4"	5 3/4"	
1,100	*	—	1"	1 1/2"	2 1/4"	3"	4"	5"	R=354' MIN. RAD.	
1,000	*	—	1"	1 3/4"	2 1/2"	3 1/2"	4 1/2"	5 1/2"		
900	*	—	1 1/4"	2"	2 3/4"	3 3/4"	5"	6"		
800	*	1/4"	1 1/2"	2 1/4"	3"	4 1/4"	5 1/2"	R=891' MIN. RAD.		
700	*	1"	1 1/2"	2 1/2"	3 1/2"	4 3/4"	R=704' MIN. RAD.			
600	—	1"	1 3/4"	3"	4 1/4"	5 3/4"				
500	—	1 1/4"	2 1/4"	3 1/2"	5"	R=539' MIN. RAD.				
450	—	1 1/2"	2 1/2"	3 3/4"	5 1/2"					
400	—	1 1/2"	2 3/4"	4 1/4"	6"					
350	1/4"	1 3/4"	3 1/4"	5"	R=396' MIN. RAD.					
300	1"	2"	3 3/4"	5 3/4"						
250	1"	2 1/2"	4 1/2"	R=275' MIN. RAD.						
200	1 1/2"	3"	5 3/4"							
150	1 3/4"	4 1/4"	R=176' MIN. RAD.							
100	2 3/4"	6"								
82	3 1/4"	R=99' MIN. RAD.								

FOR LRT ONLY

$E = 2.77 \frac{v^2}{r}$ FOR E UP TO 6"
SUPERELEVATION IN INCHES

LEGEND

* NO SPIRAL & NO SUPERELEVATION
— SPIRAL AND NO SUPERELEVATION

NOTES

1. THIS TABLE IS NOT APPLICABLE TO TRACKS IN THE CITY STREETS.
2. THIS TABLE IS NOT APPLICABLE TO TRACKS WHICH CARRY FREIGHT TRAFFIC.

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION
MASS TRANSIT ADMINISTRATION

PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC
MORRISON - KNUDSEN ENGINEERS, INC
CONSULTING ENGINEERS

CENTRAL LIGHT RAIL LINE

MANUAL OF DESIGN CRITERIA
ACTUAL SUPER ELEVATION

TABLE 4.1

CONFORMED 9/26/94

RADIUS of TRACK CENTERLINE	DESIGN SPEED MPH									
	10	15	20	25	30	35	40	45	50	55
20,000'	*	*	*	*	*	*	*	*	*	*
9,000'	*	*	*	*	*	*	*	*	*	*
8,000'	*	*	*	*	*	*	*	*	*	1/2"
7,500'	*	*	*	*	*	*	*	1/2"	3/4"	3/4"
6,500'	*	*	*	*	*	*	1/2"	3/4"	1"	1"
6,000'	*	*	*	*	*	*	3/4"	3/4"	1"	1 1/4"
4,500'	*	*	*	*	*	1/2"	3/4"	1"	1"	1 1/4"
4,000'	*	*	*	*	*	1/2"	3/4"	1"	1 1/4"	1 1/2"
3,500'	*	*	*	*	1/2"	3/4"	1"	1 1/4"	1 1/2"	1 3/4"
3,000'	*	*	*	*	1/2"	3/4"	1"	1 1/4"	1 3/4"	2"
2,500'	*	*	*	—	3/4"	1"	1 1/4"	1 1/2"	2"	2 1/2"
2,000'	*	*	*	1/2"	1"	1 1/4"	1 1/2"	2"	2 1/2"	3"
1,900'	*	*	—	3/4"	1"	1 1/4"	1 3/4"	2 1/4"	2 3/4"	3 1/4"
1,800	*	*	—	3/4"	1"	1 1/4"	1 3/4"	2 1/4"	2 3/4"	3 3/4"
1,700	*	*	—	3/4"	1"	1 1/2"	2"	2 1/2"	3"	4"
1,600	*	*	—	3/4"	1"	1 1/2"	2"	2 1/2"	3 1/4"	4 1/2"
1,500	*	*	1/2"	3/4"	1 1/4"	1 3/4"	2 1/4"	2 3/4"	3 1/2"	5"
1,400	*	*	1/2"	1"	1 1/4"	1 3/4"	2 1/4"	3"	4"	5 1/2"
1,300	*	*	1/2"	1"	1 1/2"	2"	2 1/2"	3 1/4"	4 1/2"	R=1331' MIN. RAD.
1,200	*	—	3/4"	1"	1 1/2"	2"	2 3/4"	3 3/4"	5 1/4"	
1,100	*	—	3/4"	1 1/4"	1 3/4"	2 1/4"	3"	4 1/4"	6"	
1,000	*	—	3/4"	1 1/4"	1 3/4"	2 1/2"	3 1/4"	5"	R=1100' MIN. RAD.	
900	*	—	1"	1 1/2"	2"	2 3/4"	4"	6"		
800	*	1/2"	1"	1 1/2"	2 1/4"	3"	5"	R=89' MIN. RAD.		
700	*	3/4"	1 1/4"	1 3/4"	2 1/2"	4"	R=704' MIN. RAD.			
600	—	3/4"	1 1/4"	2"	3"	5"				
500	—	1"	1 1/2"	2 1/2"	4 1/4"	R=539' MIN. RAD.				
450	—	1"	1 3/4"	2 3/4"	5"					
400	—	1"	2"	3 1/4"	6"					

JOINT FREIGHT & LRT TRACK

$E = 2\frac{V^2}{R}$ FOR U < 3"

$E = 3.96\frac{V^2}{R} - 3$ FOR U=3" AND 3" < E < 6"

SUPERELEVATION IN INCHES

LEGEND

- * NO SPIRAL & NO SUPERELEVATION
- — SPIRAL AND NO SUPERELEVATION

NOTES

1. THIS TABLE DOES NOT APPLY TO THE TRACKS IN THE CITY STREETS.

STATE OF MARYLAND DEPARTMENT OF TRANSPORTATION
MASS TRANSIT ADMINISTRATION

PARSONS, BRINCKERHOFF QUADE & DOUGLAS, INC
MORRISON - KNUDSEN ENGINEERS, INC
CONSULTING ENGINEERS

CENTRAL LIGHT RAIL LINE

MANUAL OF DESIGN CRITERIA
ACTUAL SUPER ELEVATION

TABLE 4.2

CONFORMED 9/26/94

Vehicle Znveiope

	no mirrors	*with mirrors*
Static width of vehicle (ft):	9.50	10.58
Static 1/Z width (`t).	4.75	5.29
Dynamic width (ft):	11.02	11.95
Dynamic 1/2 width (ft):	5.51	5.98
Dynamic effect on 1/2 width (ft):	0.76	0.68
Dynamic effect on 1/2 width (in):	9.12	8.16

Horizontal throw between trucks: Ci = (1450/R)*1/12 + 4.75

Horizontal throw outside trucks

without mirrors: Cc = (2835/R)*1/12 + 4.75

with mirrors: Cc = (3745/R)*1/12 + 5.29

Additional effect of vehicle dynamics:

between trucks K - 0 . 76 feet

outside trucks without mirrors K = 0.76 feet

outside trucks with mirrors K i 0.68 feet

Effect of superelevation:	quage	Worst Case Height	factor
between tt-scks	4.79	12.50	0.2174
outside trucks without cirrors	4.79	0.33	0.0058
outside trucks with mirrors	4.79	9.71	0.1689

Total --nvelope Requirements (half width):

between trucks Tt = Ci + 0.76 + 0.22 * (Es)

outside trucks without mirrors Ta = Cc + 0.76 - 0.22 * (Es)

outside z;ucks with mirrors Ta = Cc +-0.68 ^ 0.17 * (Es)

CONFORMED 9/26/84

TABLE ~.3
DYNAMIC HALF WIDTH OF *VEHICLE TOWARDS* CURVE CENTER
VALUES FOR *Tw (FEET)*

:r^re oriz. 7yn.

Envelope (T:.) in feet Radius R (Lt)	T:i.-dw Ci -(ft)	Allow. K (ft)	Including Superelevation (Es) 'n inches 0	1	2	3	4	5	6
10000	4.76	0.76	5.52	5.74	5.96	6.18	6.39	6.61	6.83
8000	4.77	0.76	5.53	5.74	5.96	6.18	6.40	6.61	6.83
6000	4.77	0.76	5.53	5.75	5.97	.6.18	6.40	6.62	6.84
4000	- 4.78	0.76	5.54	5.76	5.98	6.19	6.41	6.63	6.85
3500	4.78	0.76	5.55	5.76	5.98	6.20	6.42	6.63	6.85
3000	4.79	0.76	5.55	5.77	5.99	6.20	6.42	6.64	6.86
2500	4.80	0.76	5.56	5.78	5.99	6.21	6.4.3	6.65	6.86
2000	4.81	0.76	5.57	5.79	6.01	6.22	6.44	6.66	6.88
1900	4.81	0.76	5.58	5.79	6.01	6.23	6.44	6.66	6.88
1800	4.82	0.76	5.58	5.80	6.01	6.23	6.45	6.67	6.88
1700	4.82	0.76	5	58	5.80	6.02	6.23	6.45	6.67
	6.89								
1600	4.83	0.76	. 5.59	5.80	6.02	6.24	6.46	6.67	6.89
1500	4.83	0.76	. 5.59	5.81	6.03	6.24	6.46	6.68	6.90
1400	4.84	0.76	. 5.60	5.82	6.03	6.25	6.47	6.68	6.90
1300	4.84	0.76	. 5.60	5.82	6.04	6.26	6.47	6.69	6.91
1200	4.85	0.765	. 5.61	5.83	6.05	6.26	6.48	6.70	6.92
1100	**4.86**	**0.76**	. 5.62	5.84	6.06	6.27	6.49	6.71	6.93
1000	4.87	0.76	. 5.63	5.85	6.07	6.28	6.50	6.72	**6.94**
950	**4.88**	**0.76**	. 5.64	5.86.	6.07	6.29	6.51	6.73	6.94
900	4.88	0.76	. 5.65	5.86	6.08	6.30	6.52	6.73	6.95
850	4.89	0.76	. 5.65	5.87	6.09	6.31	6.52	6.74	6.96
800	4.90	0.76	. 5.66	5.88	6.10	6.31	6.53	6.75	6.97
750	4.91	0.76	. 5.67	5.89	6.11	6.33	6.54	6.76	6.98
700	4.92	0.76	. 5.68	5.90	6.12	6.34	6.55	6.77	6.99
650	4.94	0.76	. 5.70	5.92	6.13	6.35	6.57	6.78	7.00
i00	4.95	0.76	. 5.71	5.93	6.15	6.37	6.58	6.80	7.02
550	4.97	0.76	. 5.73	5.95	6.17	6.38	6.60	6.82	7.04
500	4.99	0.765	. 5.75	5.97	6.19	6.41	6.62	6.84	7.06
495	4.99	0.76	. 5.76	5.97	6.19	6.41	6.63	6.84	7.06
'490	5.00	0.76	. 5.76	5.98	6.19	6.41	6.63	6.85	7.06
485	5.00	0.76	. 5.76	5.98	6.20	6.41	6.63	6.85	7.07
480	'	5.0 0	0.76		5.76	5.98	6.20	6.42	6.63
	6.85	7.07							
475	5.00	0.76	. 5.77	5.98	6.20	6.42	6.64	6.85	7.07
470	5.01.	0.76	. 5.77	5.99	6.20	6.42	6.64	6.86	7.07
465	5.01	0.76	. 5.77	5.99	6.21	6.42	6.64	6.86	7.08
460	5.01	0.76	. 5.77	5.99	6.21	6.43	6.64	6.86	7.08
455	5.02	0.76	. 5.78	5.99	6.21	6.43	6.65	6.86	7.08
450	5.02	0.76	. 5.78	6.00	6.22	6.43	6.65	6.87	7.08
445	5.02	0.76	. 5.78	6.00	6.22	6.44	6.65	6.87	7.09
440	5.02	0.76	. 5.79	6.00	6.22	6.44	6.66	6.87	7.09
435	5.03	0.76	. 5.79	6.01	6.22	6.44	6.66	6.88	7.09
430	5.03	0.76	. 5.79	6.01	6.23	6.44	6.66	6.88	7.10
425	5.03	0.76	. 5.80	6.01	6.23	6.45	6.67	6.88	7.10
420	5.04	0.76	i 5.30	5.02	6.23	6.45	6.67	6.89	7.10

TABLE 4.3
DYNAMIC HALF WIDTH OF VEHICLE TOWARDS CURVE CENTER
VALUES FOR Tt (FEET)

Curve Radius	Hariz. Dyn. Throw Allow.		Envelope (Tt) in feet Including Superelevation (Es) in inches						
R	Ci	X							
(ft)	' (ft)	(ft)	0	1	2	3	4	5	6
415	5.04 ~~	0.76	5.80	6.02	6.24	6.46	6.67	6.89	7.11
410	5.04	0.76	5.81	6.02	6.24	6.46	6.68	6.89	7.11
405	5.05	0.76	5.81	6.0 3	6.24	6.46	6.68	6.90	7.11
400	5.05	0.76	5.81	6.03	6.25	6.47	6.68	6.90	7.12
395	5.06	0.76	5.82	6.04	6.25	6.47	6.69	6.90	7.12
390	5.06	0.76	5.82	6.04	6.26	6.47	6.69	6.91	7.13
385	5.06	0.76	5.83	6.04	6.26	6.48	6.70	6.91	7.13
380	5.07	0.76	5.83	6.05	6.26	6.48	6.70	6.92	7.13
375	5.07	0.765	5.83	6.05	6.27	6.49	6.70	6.92	7.14
370	5.08	0.76	5.84	6.06	6.27	6.49	6.71	6.93	7.14
365	5.08	0.76	5.84	6.06	6.28	6.49	6.71	6.93	7.15
360	5.09	0.76	5.85	6.06	6.28	6.50	6.72	6.93	7.15
355	5.09	0.76	5.85	6.07	6.29	6.50	6.72	6.94	7.16
350	5.10	0.76	5.86	6.07	6.29	6.51	6.73	6.94	7.16
345	5.10	0.76	5.86	6.08	6.30	6.51	6.73	6.95	7.17
340	5.11	0.76	5.87	6.08	6.30	6.52	6.74	6.95	7.17
335	**5.11**	**0.76**	5.87	6.09	6.31	6.52	6.74	6.96	7.18
330	5.12	0.76	5.88	6.10	6.31	6..	53	6.75	6.96
7.18									
325	5.12	0.76	5.88	6.10	6.32	6.54	6.75	6.97	7.19
320	5.13	0.76	5.89	6.11	6.32	6.54	6.76	6.98	7.19
315	5.13	0.76	5.90	6.11	6.33	6.55	6.76	6.98	7.20
310	5.14	0.76	5.90	6.12	6.34	6.55	6.77	6.99	7.21
305	5.15	0.76	5.91	6.13	6.34	6.56	6.78	6.99	7.21
300	5.15	0.76	5.91	6.13	6.35	6.57	6.78	7.00	7.22
295	5.16	0.76	5.92	6.14	6.36	6.57	6.79	7.01	7.23
290	5.17	0.76	5.93	6.15	6.36	6.58	6.80	7.02	7.23
285	5.17	0.76	5.94	6.15	6.37	6.59	6.81	7.02	7.24
280	5.18	0.76	5.94	6.16	6.38	6.60	6.81	7.03	7.25
275	5.19	0.76	5.955	6.17	6.39	6.60	6.82	7.04	7.26
270	5.20	0.76	5.96	6.18	6.39	6.61	6.83	7.05	7.26
265	5.21	0.76	5.97	6.19	6.40	6.62	6.84	7.05	7.27
260	5.21	0.76	5.98	6.19	6.41	6.63	6.85	7.06	7.28
255	5.22	0.76	5.99	6.20	6.42	6.64	6.86	7.07	7.29
250	5.23	0.76	6.00	6.21	6.43	6.65	6.86	7.08	7.30
245	5.24	0.76	6.00	6.22	6.44	6.66	6.87	7.09	7.31
240	5.25	0.76	6.02	6.23	6.45	6.67	6.88	7.10	7.32
235	5.26	0.76	6.03	6.24	6.46	6.68	6.90	7.11	7.33
230	5.28	0.76	6.04	6.25	6.47	6.69	6.91	7.12	7.34
225	5.29	0.76	6.05	6.27	6.48	6.70	6.92	7.14	7.35
220	5.30	0.76	6.06	6.28	6.50	6.71	6.93	7.15	7.37
215	5.31	0.76	6.07	6.29	6.51	6.73	6.94	7.16	7.38
.210	5 .	33	0.76	6.09	6.30	6.52	6.74	6.96	7.17 7.39
7n5	9.14	n.76	[illegible]	[illegible]	[illegible]	x_75	~.?7	..	a: 7.:1
200	5.35	0.76	j	6.12	6.33	6.55	6.77	6.99	7.20 7.42

TABLE 4 . 3
DYNAMIC iALF WIDTH OF VE-HICI.E TOWARDS CURVE CENTER
VALUES FOR Tt (-FEET)

-••rve Radius R Ci (ft.) ~ft)	Hor'_z. Throw K (ft)	I	Dyn. Allow. e	Envelope (Tt) in feet Including Superelevation (Es) in inches 1 2	3	4	5	6	
195	5.37		0.766.13	6.35	6.57	6.78	7.00	7.22	7.44
190	5.39		0.766.15'	6.37 6.58	6.80	7.02	7.23	7.45	
185	5.40		0.766.16	6.38	6.60	6.82	7.03	7.25	7.47
180	5.42		0.766.18	6.40	6.62	6.84	7.05	7.27	7.49
175	5.44		0.766.20	6.42	6.64	6.85	7.07	7.29	7.51
170	5.46		0.766.22	6.44	6.66	6.87	7.09	7.31	7.53 '
165	5.48		0.766.24	6.46	6.68	6.90	7.11	7.33	7.55
160	5.51		0.766.27	6.48	6.70	6.92	7.14	7.35	7.57
155	5.53		0.766.29	6.51	6.73	6.94	7.16	7.38	7.60
150	5.56		0.766.32	6.53	6.75	6.97	7.19	7.40	7.62
145	5.58	0.76	6.35	6.56	6.78	7.00	7.21	7.43	7.65
140	5.61	0.76	6.37	6.59	6.81	7.03	7.24	7.46	7.68
135	5.65	0.76	6.41	6.62	6.84	7.06	7.28	7.49	7.71
130	5.68	0.76	6.44	6.66	6.88	7.09	7.31	7.53	7.75
125	5.72	0.76	6.48	6.70	6.91	7.13	7.35	7.57	7.78
120	5.76	0.76	6.52	6.74	6.95	7.17	7.39	7.61	7.82
115	5.80	0.76	6.56	6.78	7.00	7.21	7.43	7.65	7.87
110	**5.85**	**0.76**	6.61	6.83	7.04	7.26	7.48	7.70	7.91
105	5.90	0.76	6.66	6.88	7.10	7.31	7.53	7.75	7.97
100	5.96	0.76	6.72	6.94	7.15	7.37	7.59'	7.81	8.02
95	6.02	0.76	6.78	7.00	7.22	7.44	7.65	7.87	8.09
90	6.09	0.76	6.85	7.07	7.29	7.51	7.72	7.94	8.16
85	6.17	0.76	6.93	7.15	7.37	7.59	7.80	8.02	8.24
82	6.22	0.76	6.99	7.20	7.42	7.64	7.85	8.07	8.29

CONFORMED 9/2fi/94

7 AE 14. 4

DYNAMIC HALE WIDTH OF VEHICLE AWAY FROM CURVE CENTER

VALUES -OR '='a (.vv-ET) -- WITH MIRRORS

:carve Radius R Co (ft) (ft)	Horiz. Dyn. Throw Allow.	K (ft)	I	Envelope (Ta) in feet Including Superelevation (Es) ?n inches 0	1 2		3	4	5	6
_0000.	5.32	0.68		6.01	5.84	5.67	5.50	5.33	5.16	4.99
8000	5.33	0.68		6.01	5.85	5.68	5.51	5.34	5.17	5.00
6000	5.34	0.68		6.03	5.86	5.69	5.52	5.35	5.18	5.01
4000	5.37	0.68		6.05	5.88	5.72	5.55	5.38	5.21	5.04
3500	5.38	0.68		6.06	5.90	5.73	5.56	5.39	5.22	5.05
3000	5.40	0.68		6.08	5.91	5.74	5.57	5.40	5.24	5.07
2500	5.42	0.68		6.10	5.93	5.76	5.59	5.43	5.26	5.09
2000	5.45	0.68		6.13	5.96	5.79	5.63	5.46	5.29	5.12
1900	5.46	0.68		6.14	5.97	5.80	5.63	5.46	5.30	5.13
1800	5.47	0.68		6.15	5.98	5.81	5.64	5.47	5.30	5.14
'700	5.48	0.68		6.16	5.99	5.82	5.65	5.48	5.31	5.15
1600	5.49	0.68		6.17	6.00	5.83	5.66	5.50	33.33	5.16
1500	5.50	0.68		6.18	6.01	5.85	5.68	5.51	5.34	5.17
1400	5.51	0.68		6.20	6.03	5.86	5.69	5.52	5.35	5.19
1300	5.53	0.68		6.22	6.05	5.88	5.71	5.54	5.37	5.20
1200	5.55	0.68		6.24	6.07	5.90	5.73	5.56	5.39	5.22
1100	**5:58**	**0.68**		6.26	6.09	5.92	5.75	5.58	5.42	5.25
1000	**5.60**	**0.68**		6.29	6.12	5.95	5.78	5.61	5.44	5.27
950	**5.62**	**0.68**		6.30	6.14	5.97	5.80	5.63	5.46	5.29
900	**5.64**	**0.68**		6.32	6.15	5.98	5.82	5.65	5.48	5.31
850	5.66	0.68		6.34	6.17	6.01	5.84	5.67	5.50	5.33
800	5.68	0.68		6.37	6.20	6.03	5.86	5.69	5.52	5.35
750	5.71	0.68		6.39	6.22	6.05	5.89	5.72	5.55	5.38
700	5.74	0.68		6.42	6.25	6.08	5.91	5.75	5.58	5.41
650	5.77	0.68		6.46	6.29	6.12	5.95	5.78	5.61	5.44
600	5.81	0.68	I	6.50	6.33	6.16	5.99	5.82	5.65	5.48
550	5.86	0.68		6.54	6.37	6.21	6.04	5.87	5.70	5.53
500	5.92	0.68		6.60	6.43	6.26	6.09	5.92	5.76	5.59
495	5.92	0.68		6.61	6.44	6.27	6.10	5.93	5.76	5.59
490	5.93	0.68		6.61	6.44	6.27	6.11	5.94	5.77	5.60
485	5.94	0.68		6.62	6.45	6.38	6.11	5.94	5.77	5.61
480	5.94	0.68		6.63	6.46	6.29	6.12	5.95	5.78	5.61
475	5.95	0.68		6.63	6.46	6.30	6.13	5.96	5.79	5.62
470	5.96	0.68		6.64	6.47	6.30	6.13	5.96	5.80	5.63
465	5.96	0.68		6.65	6.48	6.31	6.14	5.97	5.80	5.63
460	5.97	0.68		6.65	6.49	6.32	6.15	5.98	5.81	5.64
455	5.98	0.68		6.66	6.49	6.222	6.16	5.99	5.62	5.65
450	5.99	0.68		6.67	6.50	6.33	6.16	5.99	5.82	5.66
445	5.99	0.68		6.68	6.5i	6.34	6.17	6.00	5.83	5.66
440	6.00	0.68		6.69	6.52	6.35	6.18	6.01	5.84	5.67
435	6.01	0.68		6.69	6.52	6.36	6.19	6.02	5.85	5.68
430	6.02	0.68		6.70	6.53	6.36	6.19	6.03	5.86	5.69
¤.....~. w~		~....		::.	o. , _ .,		:~	6.37	0.20	6.03
5.87.. 5.70										
420	6.03	0.68	j	6.72	6.55	6.38	6.21	6.04	5.87	5.71

': ABLE -:. 4

7YNAMIC KALc wi~ GF Vr_jjIC::. :.WAY FROM CURVE CENTER

VALUES FOR '^a (FEE':') ° WITH MIRRORS

curve Radius 'Throw R (ft)	*criz.* Ca (ft)	*:)yn. Allow.* K (ft)	*Envelope (':a) in* feet *Including* Sunerelevaticn (Es) is inc:Les 0	1	2	3	4	5	6
a-415i---6.04		0~68rT	6.73	6.56	6.39	6.22	6.05	5.88	5.71
410	6.05	0.68	6.74	6.57	6.40	6.23	6.06	5.89	5.72
405	6.06	0.68	6.75	6.58	6.41	6.24	6.07	5.90	5.73
400	6.07	0.68	6.76	6.59	6.42	6.25	6.08	5.91	5.74
395	6.08	0.68	6.77	6.60	6.43	6.26	6.09	5.92	33.75
390	6.09	0.68	6.78	6.61	6.44	6.27	6.10	5.93	5.76
385	6.10	0.68	6.79	6.62	6.45	6.28	6.11	5.94	5.77
380	6.11	0.68	6.80	6.63	6.46	6.29	6.12	5.95	5.78
375	6.12	0.68	6.81.	6.64	6.47	6.30	6.13	5.96	5.79
370	6.14	0.68	6.82	6.65	6.48	6.31	6.14	5.97	5.81
365	6.15	0.68	6183	6.66	6.49	6.32	6.16	5.99	5.82
360	6.16	0.68	6.84	6.67	6.50	6.34	6.17	6.00	5.83
355	6.17	0.68	6.85	6.69	6.52	6.35	6.18	6.01	5.84
350	6.18	0.68	6.87	6.70	6.53	6.36	6.19	6.02	5.85
345	6.20	0.68	6.88	6.71	6.54	6.37	6.20	6.04	5.87
340	6.21	0.68	6.89	6.72	6.56	6.39	6.22	6.05	5.88
335	**6.22**	**0.68**	6.91	6.74	6.57	6.40	6.23	6.06	5.89
330	**6.24**	**0.68**	6.92	6.75	6.58	6.41	6.25	6.08	5.91
325	**6.25**	**0.68**	6.94	6.77	6.60	6.43	6.26	6.09	5.92
320	**6.27**	**0.68**	6.95	6.78	6.61	6.44	6.28	6.11	5.94
315	6.28	0.68	6.97	6.80	6.63	6.46	6.29	6.12	5.95
310	6.30	0.68	6.98	6.81	6.64	6.48	6.31	6.14	5.97
305	6.31	0.68	7.00	6.83	6.66	6.49	6.32	6.15	5.99
300	6.33	0.68	7.02	6.85	6.68	6.51	6.34	6.17	6.00
295	6.35	0.68	7.03	6.86	6.70	6.53	6.36	6.19	6.02
290	6.37	0.68	7.05	6.88	6.71	6.55	6.38	6.21	6.04
285	6.39	0.68	7.07	6.90	6.73	6.56	6.40	6.23	6.06
280	6.41	0.68	7.09	6.92	6.75	6.58	6.41	6.25	6.06
275	6.43	0.68	7.11	6.94	6.77	6.60	6.44	6.27	6.10
270	6.45	0.68	7.13	6.96	6.79	6.62	6.46	6.29	6.12
265	6.47	0.68	7.15	6.98	6.82	6.65	6.48	6.31	6.14
260	6.49	0.68	7.18	7.01	6.84	6.67	6.50	6.33	6.16
255	6.52	0.68	7.20	7.03	6.86	6.69	6.52	6.36	6.19
250	6.54	0.68	7.22	7.06	6.89	6.72	6.55	6.38	6.21
245	6.57	0.68	7.25	7.08	6.91	6.74	6.57	6.41	6.24
240	6.59	0.68	7.28	7.11	6.94	6.77	6.60	6.43	6.26
235	6.62	0.68	7.20	7.13	6.97	6.80	6.63	6.46	6.29
230	6.65	0.68	7.33	7.16	6.99	6.83	6.66	6.49	6.32
225	6.68	0.68	7.36	7.19	7.03	6.86	6.69	6.52	6.35
220	6.71	0.68	7.39	7.23	7.06	6.89	6.72	6.55	6.38
215	6.74	0.68	7.43	7.26	7.09	6.92	6.75	6.58	6.41
210	6.78	0.68	7.46	7.29	7.12	6.96	6.79	6.62	6.45
205	6.81	0.68	7.50	7.33	7.16	6.99	6.82	6.65	6.48
200	6.85	0.68	7.5.1	7.37	7.20	7.02	6.86	6.69	6.52

CONFORMED 9/2g/94

DYNAMIC HALF WIDTH OF VEHICLE AWAY FROM CURVE CENTER
VALUES FOR Ta (~Mr'~') - WITH MIRRORS

Curve Radius	uariz. Throw	Dyn. Allow.		Envelope (Ta) i:: feet Including Superelevation (Es) in inches						
R (ft)	co (ft)	K (ft) ,		0	7.	2	3	4	5	6
__195	___~.89	__O_68_				-___7-_~___7_~i		_7_2-4--_7-07		6.90
6.73			6.56							
190	6.93	0.68		7.62	7.45	7.28	7.11	6.94	6.77	6.61
185	6.98	0.68		7.66	7.49	7.32	7.16	6.99	6.82	6.65
180	7.03	0.68		7.71	7.54	7.37	7.20	7.03	6.87	6.70
175	7.08	0.68		7.76	7.59	7.42	7.25	7.08	6.91	6.75
170	7.13	0.68		7.81	7.64	'7.47	7.30	7.14	6.97	6.80
165	7.18	0.68	I	7.87	7.70	7.53	7.36	7.19	7.02	6.85
160	7.24	0.68		7.93	7.76	7.59	7.42	7.25	7.08	6.91
155	7.31	0.68		7.99	7.82	7.65	7.48	7.31	7.14	6.98
150	7.37	0.68		8.06	7.89	7.72	7.55	7.38	7.21	7.04
145	7.44	0.68		8.13	7.96	7.79	7.62	7.45	7.28	7.11
140	7.52	0.68		8.20	8.04	7.87	7.70	7.53	7.36	7.19
135	7.60	0.68		8.29	8.12	7.95	7.78	7.61	7.44	7.27
130	7.69	0.68		8.38	8.21	8.04	7.87	7.70	7.53	7.36
125	7.79	0.68.		8.47	8.30	8.13	7.97	7.80	7.63	7.46
120	7.89	0.68		8.5'8	8.41	8.24	8.07	7.90	7.73	7.56
115	8.01	0.68		8.69	8.52	8.35	8.18	8.01	7.85	7.68
110	8.13	0.68		8.81	8.64	8.48	8.31	8.14	7.97	7.80
105	8.26	0.68		8.95	8.78	8.61	8.44	8.27	8.10	7.93
100	8.41	0.68		9.10	8.93	8.76	8.59	8.42	8.25	8.08
95	8.58	0.68		9.26	9.09	8.92	8.75	8.59	8.42	8.25
90	8.76	0.68		9.44	9.27	9.11	8.94	8.77	8.60	8.43
85	8.96	0.68		9.65	9.48	9.31	9.14	8.97	8.80	8.63
82	9.10	0.68	1	9.78	9.61	9.44	9.28	9.11	8.94	8 '17

TABLC. 4 . 5
DYNAMIC HALF WID'T'H OF VEHICLE AWAY FROM CURVE CENTER
VALUES FOR Ta (FE'E'T" - WITHOUT :MIRRORS

Curve Radius R (ft)	Co (ft)	K (ft)	Hor.; z. Oyn. Throw Allow. 0	'_	2	3	4	5	6
						Envelope (Ta) in feet including Sunerelevar-ion (Ss) in **inches**			
__i0000		,_4.77							
__n_7									
		-6_____5-.54 _			5_3-Z- --5-i0		4.88	4.67	4.45
		4.23							
8000	4.78	0.76	5.54	5.32		5.11	4.89	4.67	4.45
4.24									
6000	4.79	0.76	5.55	5.33		5.12	4.90	4.68	4.46
4.25									
4000	4.81	0.76	5.57	5.35		5.14	4.92	4.70	4.48
4.27									
3500	4.82	0.765	5.58	5.36		5.14	4.93	4.71	4.49
4.27									
3000	4.83	0.76	5.59	5.37		5.16	4.94	4.72	4.50
4.29									
2500	4.84	0.76	5.61	5.39		5.17	4.95	4.74	4.52
4.30									
2000	4.87	0.76	5.63	5.41		5.20	4.98	4.76	4.54
4.33									
1900	4.87	0.76	5.64	5.42		5.20	4.98	4.77	4.53
4.33									
1800	4.88	0.76	5.64	5.43		5.21	4.99	4.77	4.56
4.34									
1700	4.89	0.76	5.65	5.43		5.22	5.00	4.78	4.56
4.35									
1600	4.90	0.76	5.66	5.44		5.22	5.01	4.79	4.57
4.36									
1500	4.91	0.76	5.67	5.45		5.23	5.02	4.80	4.58
4.36									
1400	4.92	0.76	5.68	5.46		5.25	5.03	4.81	4.59
4.38									
1300	4.93	0.76	5.69	5.48		5.26	5.04	4.82	4.61
4.39									
1200	4.95	0.76	5.71	5.49		5.27	5.06	4.84	4.62
4.40									
1100	**4.96**	**0.76**	5.73	5.51		5.29	5.07	4.86	4.64
4.42									
1000	4.99	0.76	5.75	5.53		5.31	5.10	4.88	4.66
4.44									
950	5.00	0.76	5.76	5.54		5.33	5.11	4.89	4.67
4.46									
900	5.01	0.76	5.77		5.56	5.34	5.12	4.90	4.69
4.47									
850	5.03	0.76	5.79		5.57	5.35	5.14	4.92	4.70
4.49									
$00	5.05	0.76	5.81		5.59	5.37	5.15	4.94	4.72
4.50									
750	5.07	0.76	5.83		5.61	5.39	5.17	4.96	4.74
4.52									
700	5.09	0.76	5.85		5.63	5.41	5.20	4.98	4.76
4.54									
650	5.11	0.76	5.88		5.66	5.44	5.22	5.01	4.79
4.57									
600	5.14	0.76	5.91		5.69	5.47	5.25	5.04	4.82

/ Xr7.r.. Y . 5

DYNAMIC HALF WIDTH OF VEHICLE AWAY FROM CURVE CENTER
VALUES FOR Ta (.-FEET) - WITHOUT MIRRORS

Curve Radius R (ft)	*rioriz. Dyn.* Throw Allow. Co ' (ft)	K (-ft)	*,Envelope (Ta) in feet* including Superelevation (Es) in inches 0	1	2	3	4	5	6
415	5.32	0.76	6.08	5.86	5.65 -	5.43	5.21	4.99	4.78
410	5.33	0.76	6.09	5.87	5.65	5.44	5.22	5.00	4.78
405	5.33	0.76	6.3.0	5.88	5.66	5.44	5.23	5.01	4.79
400	5.34	0.76	6.10	5.88	5.67	5.45	5.23	5.02	4.80
395	5.35	0.76	6.11	5.89	5.68	5.46	5.24	5.02	4.81
390	5.36	0.76	6.12	5.90	5.68	5.47	5.25	5.03	4.81'
385	5.36	0.76	6.13	5.91	5.69	5.47	5.26	5.04	4.82
380	5.37	0.76	6.13	5.92	5.70	5.48	5.26	5.05	4.83
375	5.38	0.76	6.14	5.92	5.71	5.49	5.27	5.05	4.84
370	5.39	0.76'	6.15	5.93	5.72	5.50	5.28	5.06	4.85
365	5.40	0.76	6.16	5.94	5.72	5.51	5.29	5.07	4.85
360	5.41	0.76	6.17	5.95	5.73	5.52	5.30	5.08	4.86
355	5.42	0.76	6.18	5.96	5.74	5.53	5.31	5.09	4.87
350	5.43	0.76	6.19	5.97	5.75	5.53	5.32	5.10	4.88
345	5.43	0.76	6.20	5.98	5.76	5.54	5.33	5.11	4.89
340	5.44	0.76	6.21	5.99	5.77	5.55	5.34	5.12	**4.90**
335	**5.46**	**0.76**	6.22	6.00	5.78	5.56	5.35	5.13	4.9
330	5.47	0.76	6.23	6.01	5.79	5.58	5.36	5.14	4.92
325	5.48	0.76	6.24	6.02	5.80	5.59	5.37	5.15	4.93
320	5.49	0.76	6.25	6.03	5.82	5.60	5.38	5.16	4.95
315	5.50	0.76	6.26	6.04	5.83	5.61	5.39	5.17	4.96
310	5.51	0.76	6.27	6.06	5.84	5.62	5.40	5.19	4.97
305	5.52	0.76	6.29	6.07	5.85	5.63	5.42	5.20	4.98
300	5.54	0.76	6.30	6.08	5.86	5.63	5.43	5.21	4.99
295	5.55	0.76	6.31	6.10	5.88	5.66	5.44	5.23	5.01
290	5.56	0.76	6.33	6.11	5.89	5.67	5.46	5.24	5.02
285	5.58	0.76	6.34	6.12	5.91	5.69	5.47	5.25	5.04
280	5.59	0.76	6.36	6.14	5.92	5.70	5.49	5.27	5.05
275	5.61	0.76	6.37	6.15	5.94	5.72	5.50	5.28	5.07
270	5.63	0.76	6.39	6.17	5.95	5.73	5.52	5.30	5.08
265	5.64	0.76	6.40	6.19	5.97	5.75	5.53	5.32	5.10
260	5.66	0.76	6.42	6.20	5.99	5.77	5.55	5.33	5.12
255	5.68	0.76	6.44	6.22	6.00	5.79	5.57	5.35	5.13
250	5.70	0.76	6.46	6.24	6.02	5.80	5.59	5.37	5.15
245	5.71	0.76	6.48	6.26	6.04	5.82	5.61	5.39	5.17
240	5.73	0.76	6.50	6.28	6.06	5.84	5.63	5.41	5.19
235	5.76	0.76	6.52	6.30	5.03	5.86	5.65	5.43	5.21
230	5.78	0.76	6.54	6.32	6.10	5.89	5.67	5.45	5.23
225	5.80	0.76	5.!6	6.34	6.13	5.91	5.69	5.47	5.26
220	5.82	0.76	6.59	6.37	6.15	5.93	5.72	5.50	5.28
215	5.85	0.76	6.61	6.39	6.18	5.96	5.74	5.52	5.31
210	5.88	0.76	6.64	6.42	6.20	5.98	5.77	-5.55	5.3.'
20>	3.3v	--.7,5	.~ .	:,:	,i.-:j	6.2:i	6.01	5.79	5.58 4.3t
200	5.93	0.76	6.69	6.48	6.26	6.04	5.82	5.61	5.39

CONFORMED 9/2fi/9

TABLE 4 . 5
DYNAMIC *HALF WIDTH OF VEHICLE AWAY :ROM* CURVE CENTER
VALUES FOR Ta !FEET) - WITHOUT MIRRORS

Curve Radius R	Hcriz. Dyn. Throw Allow. Co	K	. (ft)	. (ft)	(ft) I	Envelope (Ta) in feet including superelevatien (Es) -n inches 0	1	2	3	4	5	6
195	5.96	0.76	6.72	6.51	6.29	6.07	5.85	5.64	5.42			
190	5.99	0.76	6.76	6.54	6.32	6.10	5.89	5.67	5.45			
185	6.03	0.76	6.79	6.57	6.35	6.14	5.92	5.70	5.48			
180	6.06	0.76	6.82	6.61	6.39	6.17	5.95	5.74	5.52			
175	6.10	0.76	6.86	6.64	6.43	6.21	5.99	5.77	5.56			
170	6.14	0.76	6.90	6.68	6.47	6.25	6.03	5.81	5.60			
165	6.18	0.76	6.94	6.73	6.51	6.29	6.07	5.86	5.64			
160	6.23	0.76	6.99	6.77	6.55	6.34	6.12	5.90	5.68			
155	6.27	0.76	7.04	6.82	6.60	6.38	6.17	5.95	5.73			
150	6.33	0.76	7:09	6.87	6.65	6.43	6.22	6.00	5.78			
145	6.38	0.76	7.14	6.92	6.71	6.49	6.27	6.05	5.84			
140	6.44	0.76	7.20	6.98	6.76	6.55	6.33	6.11	5.89			
135	6.50	0.76	7.26	7.04	6.83	6.61	6.39	6.17	5.96			
130	6.57	0.76	7.33	7.11	6.89	6.68	6.46	6.24	6.02			
125	6.64	0.76	7.40	7.18	6.97	6.75	6.53	6.31	6.10			
120	6.72	0.76	7.48	7.26	7.05	6.83	6.61	6.39	6.18			
115	6.80	0.76	7.57	7.35	7.13	6.91	6.70	6.48	6.26			
110	6.90	0.76	7.66	7.44	7.22	7.01	6.79	6.57	6.36			
105	7.00	0.76	7.76	7.54	7.33	7.11	6.89	6.67	6.46			
100	7.11	0.76	7.87	7.66	7.44	7.22	7.00	6.79	6.57			
95	7.24	0.76	8.00	7.78	7.56	7.35	7.13	6.91	6.69			
90	7.38	0.76	8.14	7.92	7.70	7.48	7.27	7.05	6.83			
85	7.53	0.76	8.29	8.07	7.86	7.64	7.42	7.20	6.99			
82	7.63	0.76	8.39	8.18	7.96	7.74	7.52	7.31	7.09			

CONFORMED 9/26/94