Illinois Department of Transportation
2300 South Dirksen Parkway / Springfield, Illinois / 62764

April 14, 2014

SUBJECT: Various Routes
Section FY2014 ITS-1
Champaign County
Contract No. 70A26
Item No. 049, April 25, 2014 Letting
Addendum A

NOTICE TO PROSPECTIVE BIDDERS:

Attached is an addendum to the plans or proposal. This addendum involves revised and/or added material.

1. Revised Schedule of Prices.
2. Revised plans sheets No.(1, 2, 4, 5, 6, , 37, 38, 39, 41, 43, 44, 47, 50, 51, 53, 55, 56, 57, 58, 59, 60, 61, 62, 67, 68, 69, 70, & 71.)
3. Added sheets (36A, 36B, 36C & 70A.) to the plans.
4. Revised Table of Contents of the Special Provisions.
5. Revised pages 7 & 47-53 of the Special Provisions.
6. Added pages 87-121 to the Special Provisions.

Prime contractors must utilize the enclosed material when preparing their bid and must include any Schedule of Prices changes in their bidding proposal.

Bidders using computer-generated bids are cautioned to reflect any and all Schedule of Prices changes, if involved, into their computer programs.

Very truly yours,

John D. Baranzelli, P.E.
Acting Engineer of Design and Environment

By: Ted B. Walschleger, P. E.
Engineer of Project Management

cc: J. E. Crowe, Region 3, District 5; Tim Kell; D. Carl Puzey; Estimates

HM/kf

ILLINOIS DEPARTMENT OF TRANSPORTATION
SCHEDULE OF PRICES
CONTRACT NUMBER - 70A26

State Job # - C-95-012-13

Project Number
***REVISED: APRIL 10, 2014**

Route
VARIOUS

County Name - CHAMPAIGN- -
Code - 19 - -
District - 5 - -
Section Number - FY2014 ITS-1

Item Number		Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
*ADD	X0323524	REM EX SURVEIL CAM EQ	EACH	1.000				
	X0324597	CCTV CABINET	EACH	7.000				
	X0325485	TR MTD LED DYN MSG SN	EACH	5.000				
	X0325810	WIRELESS ETHERNET RAD	EACH	2.000				
*ADD	X0325922	CELLULAR MODEM	EACH	5.000				
	X0326091	LP 50 W/CAM LOW SYS	EACH	6.000				
	X0326263	EQUIPMENT CABINET	EACH	1.000				
*REV	X0326266	ETHERNET SWITCH	EACH	40.000				
	X0326452	VIDEO SYS DET PROCSSR	EACH	5.000				
	X0326617	PAINT LIGHT POLE UNIT	EACH	1.000				
*REV	X0327216	CCTV CAMERA	EACH	29.000				
*ADD	X0327459	POLE CABLE REMOVAL	EACH	1.000				
	X6340205	GUARD POSTS REMOV	EACH	15.000				
*REV	X6430120	REM IMP ATTEN NO SALV	EACH	1.000				
	X7015005	CHANGEABLE MESSAGE SN	CAL DA	30.000				

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Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
X8710028	FIB OPT CBL 6F SM	FOOT	6,271.000				
*REV X8710036	FIB OPT CBL 12F SM	FOOT	9,818.000				
*REV X8710054	FO TERM PANEL 12F 24F	EACH	5.000				
*REV Z0010688	CAMERA MOUNT ASSEMBLY	EACH	11.000				
*ADD Z0013798	CONSTRUCTION LAYOUT	L SUM	1.000				
Z0033070	VIDEO VEH DET 4 CAM	EACH	5.000				
Z0076604	TRAINEES TPG	HOUR	500.000		15.000		7,500.000
20400800	FURNISHED EXCAVATION	CU YD	50.000				
25000210	SEEDING CL 2A	ACRE	0.250				
25000400	NITROGEN FERT NUTR	POUND	23.000				
25000500	PHOSPHORUS FERT NUTR	POUND	23.000				
25000600	POTASSIUM FERT NUTR	POUND	23.000				
25100115	MULCH METHOD 2	ACRE	0.250				
63000001	SPBGR TY A 6FT POSTS	FOOT	2,687.500				
63100045	TRAF BAR TERM T2	EACH	13.000				

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Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
63100167	TR BAR TRM T1 SPL TAN	EACH	14.000				
63200310	GUARDRAIL REMOV	FOOT	50.000				
63400105	GUARD POSTS	EACH	25.000				
67100100	MOBILIZATION	L SUM	1.000				
70100450	TRAF CONT-PROT 701201	L SUM	1.000				
70100800	TRAF CONT-PROT 701401	L SUM	1.000				
70102622	TR CONT & PROT 701502	L SUM	1.000				
70102630	TR CONT & PROT 701601	L SUM	1.000				
70102635	TR CONT & PROT 701701	L SUM	1.000				
70200100	NIGHT WORK ZONE LIGHT	L SUM	1.000				
73300300	OVHD SIN STR-SPAN T3A	FOOT	371.000				
73301810	OSS WALKWAY TY A	FOOT	100.000				
73400200	DRILL SHAFT CONC FDN	CU YD	110.500				
78200410	GUARDRAIL MKR TYPE A	EACH	56.000				
78201000	TERMINAL MARKER - DA	EACH	27.000				

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District - 5 - -
Section Number - FY2014 ITS-1

Item Number	Pay Item Description	Unit of Measure	Quantity	x	Unit Price	=	Total Price
80500100	SERV INSTALL TY A	EACH	5.000				
*REV 81028350	UNDRGRD C PVC 2	FOOT	17,779.000				
*REV 81300830	JUN BX SS AS 18X18X8	EACH	7.000				
*REV 81400100	HANDHOLE	EACH	23.000				
81500130	GULFBOX JUNCTION REM	EACH	1.000				
82700100	TRANSFORMER (GP)	EACH	3.000				
*REV 83600300	LIGHT POLE FDN 30D	FOOT	43.000				
86400100	TRANSCEIVER - FIB OPT	EACH	3.000				
87100020	FOCC62.5/125 MM12SM12	FOOT	1,801.000				
87300901	ELCBL C TRACER 12 1C	FOOT	7,955.000				
*REV 87301125	ELCBL C SIGNAL 12 3C	FOOT	7,197.000				
87301815	ELCBL C SERV 6 3C	FOOT	4,247.000				
*REV 87900200	DRILL EX HANDHOLE	EACH	34.000				
89502210	MOD EX CONTR CAB	EACH	17.000				
89502300	REM ELCBL FR CON	FOOT	1,473.000				

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CONTRACTOR'S RESPONSIBILITY FOR DAMAGE

The Contractor shall be held responsible for damages to a sign or sign structure resulting from the removal, transportation, handling, temporary support system, assembly, temporary storage, erection, repair procedures, and operations of equipment or employees prior to final inspection by the District. The Contractor shall, at his/her own expense, correct any Contractor-caused damage to a condition equal to that existing before damage was done, by repairing, rebuilding, or replacing it as directed by the Engineer.

MATERIALS – VERIFICATION OF PROPOSED DIMENSIONS

The Contractor shall be responsible for field verifying the proposed dimensions to ensure minimum clearance assuming a 15' sign height before ordering materials. In addition, the exact dimensions of the Dynamic Message Signs (DMS) that will be supplied are not known during the design phase. The dimensions of the DMS will determine the exact dimensions of various truss members, such as the sign bracket supports and the walkway bracket supports. The Contractor shall be responsible for verifying all dimensions prior to ordering materials.

PROPOSED LOCATIONS AND LAYOUT OF NEW SIGN TRUSSES

End support heights in the plans for simple span trusses are based on providing a minimum 17'-3" clearance, using a sign height of 15.0' (per base sheet OS4-A-8a) as opposed to the tallest existing sign height. This is to account for any future changes in sign heights. The Contractor shall not make adjustments to the end supports heights provided in the plans without approval from the Engineer.

5 S 010 I057 R226.45
This I-57 NB sign structure is to be constructed at station 472+50 just South of overhead bridge 010-0179. Benchmark BM – 4958-1 with an elevation of 685.96 has been established as a chiseled square on top of the SE corner of east headwall of across road box culvert 010-8011 sta. 472+79.75, 80.97' Rt. This BM was used to establish the elevations given in this set of plans and was used in the design of the new end supports. This BM can be used by the contractor to aid with layout.

Revised 4/14/14

WIRELESS ETHERNET RADIO

This work shall consist of providing and installing an ethernet radio and antenna at the following locations:

I-57 & I-74 interchange (exist. light pole 49-134; along with new camera and cabinet)

Mattis Ave. & Bloomington Rd. intersection (on mast pole with camera)

The ethernet radios shall be Intuicom Nitro58 wireless 802.11a or the pre-approved equivalent.

The proposed ethernet radios shall accept ethernet input direct from the camera.

The mounting height and positioning of the antenna shall be per the approval of the engineer.

This work shall be paid for at the contract unit cost EACH for WIRELESS ETHERNET RADIO and shall include all labor, hardware, electrical connections and any other material necessary for the complete working installation and communication of all components. No additional compensation will be allowed.

DRILL EXISTING HANDHOLE

This work shall consist of drilling all the proper sized holes at a specified handhole to complete conduit installation. Each hole drilled will be considered as a unit.

This work will be paid for at the contract unit price per EACH for DRILL EXISTING HANDHOLE and no additional compensation will be allowed.

Revised 4/14/14

SPEED DISPLAY TRAILER (BDE)

Effective: April 2, 2014

Add the following to Article 701.15(l) of the Standard Specifications:

" (l) Speed Display Trailer. A speed display trailer shall be utilized on freeways and expressways as part of Highway Standard 701400. The trailer shall be placed on the right hand side of the roadway adjacent to, or within 100 ft (30 m) beyond, the first work zone speed limit sign.

Whenever the speed display trailer is not in use, it shall be considered non-operating equipment and shall be stored according to Article 701.11."

Add the following to Article 701.20 of the Standard Specifications:

" (k) Speed Display Trailer will be paid for at the contract unit price per calendar month or fraction thereof for each trailer as SPEED DISPLAY TRAILER."

Add the following to Article 1106.02 of the Standard Specifications:

" (o) Speed Display Trailer. The speed display trailer shall consist of a LED speed indicator display with self-contained, one-direction radar mounted on an orange see-through trailer. The height of the display and radar shall be such that it will function and be visible when located behind concrete barrier.

The speed measurement shall be by radar and provide a minimum detection distance of 1000 ft (300 m). The radar shall have an accuracy of ±1 mile per hour.

The speed indicator display shall face approaching traffic and shall have a sign legend of "YOUR SPEED" immediately above or below the speed display. The digital speed display shall show two digits (00 to 99) in mph. The color of the changeable message legend shall be a yellow legend on a black background. The minimum height of the numerals shall be 18 in. (450 mm), and the nominal legibility distance shall be at least 750 ft (250 m).

The speed indicator display shall be equipped with a violation alert that flashes the displayed detected speed when the posted limit is exceeded. The speed indicator shall have a maximum speed cutoff. The display shall include automatic dimming for nighttime operation.

The speed indicator measurement and display functions shall be equipped with the power supply capable of providing 24 hours of uninterrupted service."

Revised 4/14/14

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Revised 4/14/14

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Revised 4/14/14

TERMINATION OF FIBER OPTIC CABLES WITH FUSION SPLICED ST CONNECTORS

Description. The Contractor shall terminate a single mode fiber by fusion splicing a factory-formed ST connector (from a pre-formed fiber optic patch cable) onto a field fiber at the locations shown on the Plans.

Materials. The Contractor shall be responsible for ensuring that the pre-formed ST connector fiber is compatible with the field fiber that it will be fusion splice to.

The splice shall be protected with a protection sleeve/enclosure that will secure both cables and prevent cable movement.

Revised 4/14/14

GROUNDING OF ITS STRUCTURES

This work shall be in accordance with the applicable articles of Sections 807, 817 and 1066 of the Standard Specifications with the following modifications:

This work shall consist of furnishing and installing a grounding wire to connect all proposed DMS structures and camera poles in accordance with NEC requirements.

The proposed ground wire shall be the third (3rd) conductor of the service cable installed to the power source. This wire shall be bonded to all items and their associated ground rods utilizing mechanical lugs and bolts. This wire may be made continuous by splicing in the adjacent handholes with compression lugs. Split bolts will not be allowed.

The grounding wire shall be bonded to the grounded conductor at the service disconnect per the NEC.

All clamps, hardware, and other materials required shall be included.

Basis of Payment: This work will not be paid for separately, but shall be included in the unit bid prices for their associated items.

TRUSS MOUNTED LED DYNAMIC MESSAGE SIGN

Description

This work consists of providing a truss mounted dynamic message sign (TMDMS) at the locations shown on the Plans and as directed by the Engineer. Truss mounted dynamic message sign assembly includes the TMDMS enclosure, communication cables, conduits, and associated mounting hardware and software as described in these Special Provisions and as shown on the contract Plans. It also includes operational TMDMS software that remotely provides access to the functionality and performance specified herein.

TMDMS Manufacturer Qualifications

The TMDMS Manufacturer shall submit references as specified below. Reference data shall include current name and address of organization, and the current name and telephone number of an individual from the organization who can be contacted to verify system operation, as well as date of system installation.

Added 4/14/14

Experience Requirements

The TMDMS Manufacturer shall submit at least two references, preferably from other state departments of transportation, that are successfully operating a highway LED full matrix TMDMS system, supplied by this manufacturer under the current corporate name, which otherwise meets this specification, for a period of no less than two years. The LED TMDMS systems submitted shall be full-matrix and able to display at least 3 lines of 18 characters per line, 18" characters and have walk-in access housings.

References

The TMDMS Manufacturer shall submit three references, preferably from other state departments of transportation, that are successfully operating a multi-unit, multi-lane state or interstate highway, permanently-mounted, overhead dynamic message sign system supplied by this manufacturer under the current corporate name, for a period of no less than five years.

Materials

General

The TMDMS shall be of the Daktronics brand or the pre-approved equivalen in accordance with the following provisions in order to maintain compatability with the existing ITS system currently in place in IDOT's Region3 / District 5:

The TMDMS shall be a full matrix amber LED display in a walk-in weatherproof cabinet. The TMDMS shall provide approaching motorists with a clear readable message in all normally encountered weather and lighting conditions. The TMDMS shall be capable of displaying messages with three lines, eighteen characters per line, at an eighteen inch character height.

The sign shall be designed for a minimum life of 20 years.

All materials furnished, assembled, fabricated or installed under this item shall be new, corrosion resistant and in strict accordance with the details shown in the plans and as detailed in this specification. All details and functionality listed in this specification will be thoroughly inspected and tested by the Department. Failure to meet all details and functionality detailed in this specification shall be grounds for rejection of the equipment.

The equipment design and construction shall utilize the latest available techniques with a minimum number of different parts, subassemblies, circuits, cards and modules to maximize standardization and commonalty. The equipment shall be designed for ease of maintenance. All component parts shall be readily accessible for inspection and maintenance. Test points shall be provided for checking essential voltages.

The sign shall be designed and constructed so as to present a clean and neat appearance.

All cables shall be securely clamped/tied in the sign housing. No adhesive attachments will be allowed.

Added 4/14/14

The performance of the sign shall not be impaired due to continuous vibration caused by wind, traffic or other factors. This includes the visibility and legibility of the display.

The TMDMS hardware, along with the sign controller hardware, software and firmware, shall support all TMDMS functionality described throughout the remaining specification sections.

The TMDMS assembly shall be listed by an accredited 3rd party testing organization for conformance to Underwriters Laboratories (UL) standards 48 (Standard for Electric Signs) and 1433 (Control Centers for Changing Message Signs). Proof of this conformance shall be provided with submittal materials.

Environmental Requirements

The TMDMS shall withstand the following environmental conditions for 24 hours or more with no functional or performance degradation, permanent deformation or other damages:

Temperature:	-40 to +140°F (-40 to 60°C)
Humidity:	0 to 100 %
Wind:	To at least 90 mph with a 30% gust factor
Ice:	Front face ice load of 4 pounds per square foot

All field equipment enclosures shall be designed to withstand the effects of sand, dust, and hose-directed water. All connections shall be watertight.

Functional Requirements

The TMDMS shall be capable of accepting commands, displaying messages and returning status as required by the current version (v2) National Transportation Communications for ITS Protocol (NTCIP) Specifications applicable for TMDMS and as specified in these special provisions. The TMDMS shall communicate without error for all of the applicable National Transportation for Intelligent Transportation System Protocol (NTCIP) standards and be compliant with all applicable NTCIP standards for TMDMS. The TMDMS shall support all mandatory objects of all mandatory conformance groups of NTCIP for TMDMS.

The TMDMS shall enable the display of text, consisting of a string of alphanumeric and other characters. Each character shall be formed by a matrix of luminous pixels. The matrix of a standard character shall consist of 35 pixels over 5 columns and 7 rows. Each TMDMS shall be minimum 27 pixel high x 125 pixel wide, full matrix and capable of displaying three lines of text using a standard 5 wide x 7 high font size. All display elements and modules shall be solid state. No mechanical or electromechanical elements or shutters shall be used.

All characters, symbols, and digits shall be 18” nominal character size and shall be clearly visible and legible at a distance of 1100’ within a minimum 30 degree cone of vision centered around the optical axis of the pixel.

Added 4/14/14

The signs shall be capable of displaying the following:

- A static message
- A flashing message
- Alternating messages, either flashing or static

The changing from one message to another shall be instantaneous.

For message creation, the TMDMS field controller, and TMDMS control software shall support the storage and use of a minimum of three (3) alphanumeric character font files comprising the ASCII character set and including 8 directional arrows. Software shall provide the ability to create and maintain message libraries containing up to 255 messages.

Software

The Contractor shall supply fifteen licenses of remote control and sensing software used to control and interrogate the signs. This software shall provide interoperability with all other signs supplied under this contract including the five (5) existing signs currently in operation in McLean county utilizing Daktronics VFC 300 controllers. The software shall be designed to run on a workstation under Windows 7 and Windows Server 2008, either remotely, using the communications link connected to the TMDMS; or locally, from a laptop computer connected to the sign controller communications port. The software shall display the message to be downloaded to operators exactly as it will appear on the destination TMDMS and shall provide verification back to the operators that the actual message has been visibly displayed on the destination TMDMS on an individual pixel basis.

The software shall include functionality for message scheduling (based on date and time), message priority queuing and DMS diagnostics.

The software shall be capable of sending multiple messages to multiple signs based on a user programmable time schedule. Primary communication shall be by direct ethernet connectivity via fiber optic signal. Backup communication shall be accomplished through cellular wireless services in the event of a loss of ethernet connectivity. The cellular modem and service will be paid for under a separate pay item.

TMDMS control software shall support the creation of user ID's and passwords for up to 25 potential system users. User creation, as well as individual user access rights, shall be assignable only by a "System Administrator".

Before a system operator can use the TMDMS control software, the software shall request a "user name" and user "password". If the correct user name and password are not provided, access to the software shall be declined.

An 8-bit identification code shall be assignable to each controller, via switches located inside the controller enclosure. The software shall control a network of at least 250 variable message signs.

Added 4/14/14

The software shall have the following functionality:

Display Control:	• View, group, and monitor DMS in real time • Controls any NTCIP-compliant DMS (Any DMS configuration, Portable NTCIP message displays) • Powerful list view or map view • Pre-schedule event scenarios • Scheduled status polling of DMS
Messaging:	• Full suite of message and graphic tools • Message changing depending time and date • Adjust message duration and priority • Time based scheduled DMS polling
Communications:	• Run nearly unlimited signs at once from traffic management centers with client-server architecture • Supports Ethernet and serial (COM Port) connections • Supports modem pools
Diagnostics:	• Log events and alert TMC staff via email • Locate pixel failures instantly with an in-software visual representation test • View status, errors, and problem codes of all DMS subsystems • Verify and troubleshoot at the pixel level
Security:	• Real-time verification of "on" pixels • Username/password restricted access to functional areas • Built-in security levels for easy setup • Prohibited words list

In the event that the software is not capable of operating on a laptop that is connected directly to the DMS sign, the Contractor shall provide ten additional licenses of software that can be used in the field to manage the DMS and perform sign diagnostics.

The vendor shall furnish updated copies of all software during the warranty period of 10 years at no charge to the Department.

The vendor shall be responsible for setting up the software in the workstations at the District 5 Communications Center as well as the District 5 Sign Shop. The vendor will be responsible for satisfactorily configuring the software to control the five (5) signs on the this contract as well as the five (5) existing signs currently operating in Mclean County utilizing Daktronics VFC 3000 controllers.

Added 4/14/14

Software Documentation

Full documentation for all software and associated protocols shall be supplied to the Department on a CD-ROM. The Department reserves the right to provide this documentation to other parties who may be contracted with in order to provide overall integration or maintenance of this item.

Performance Requirements

TMDMS messages shall be clearly visible and legible from in-vehicle viewing distances between 150 and 1100 feet. While using an 18 in character height, the TMDMS shall be capable of simultaneously displaying up to 18 characters in each of three lines with spaces between characters, using 5 horizontal X 7 vertical (or larger) pixel matrices.

The TMDMS controller shall be capable of storing a minimum of 32 three-line full width messages. The controller shall be capable of downloading a minimum of 8 additional messages and commands from the communications interface.

The sign shall provide a, RS-232 communications interface in the sign control cabinet suitable for wireless, PSTN, cellular, and fiber optic communications with the sign controller. Additionally, an RS-232 serial port and Ethernet port shall be provided in the control cabinet for full sign operation by means of a laptop computer. Each serial port shall support data rates of 19.2 kbps, 14.4 kbps, 9600 bps, 4800 bps, 2400 bps, and 1200 bps.

Optical Requirements

All mandatory NTCIP sign functions shall be available and message effects shall be visible from the ground-mounted sign control cabinet.

The viewing angle of each discrete LED-formed pixel shall be a minimum cone of 30 degrees around a line normal to the TMDMS viewing surface. The intensity of each pixel shall not decrease more than 30% over the twenty-year life of the sign.

If pulse-width modulation is used for intensity control, the sign drive electronics shall use a refresh or repetition rate of 100 Hz or greater.

The TMDMS walk-in cabinet shall mount three or more light sensors, one angled in a northerly direction away from nearby lighting, scaled for 100 lux, and two normal to the sign face, pointing in opposite directions, scaled for 100,000 lux. Each sensor shall have an adjustable aiming angle. The TMDMS shall be capable of automatic dimming.

Added 4/14/14

Characters Displayed

The sign shall be capable of displaying ASCII characters 32 through 126 and the following characters at any location in the message line:

“A” thru “Z”- All upper case letters.
“0” thru “9”- All decimal digits.
Space (i.e., ASCII code 0x20).
Punctuation marks shown in brackets [. , ! ? - ‘ ’ “ ” / ( )]
Special characters shown in brackets [# & * +< >]
3 pixel wide dash

The display modules shall be rectangular, and shall have an identical vertical and horizontal pitch between pixels. The pitch shall be no greater than 2 ¾”.

The separation between the last column of one display module and the first column of the next shall be equal to the horizontal distance between the columns of a single display module.

The characters shall be legible under all light conditions at a distance of 1100’ within a 30° degree cone of vision centered around the optical axis of the pixel.

The sign shall be the proper brightness in all lighting conditions for optimum legibility. It shall be bright enough to have a good target value, but not to the point where the pixels bloom, especially in low ambient light level conditions.

The brightness and color of each pixel shall be uniform over the entire face of the sign within the fifteen degree cone of vision from 1100’ to 200’ in all lighting conditions. Non-uniformity of brightness or color over the face of the sign under these conditions shall be cause for rejection of the sign.

Electronic Materials and Components

All electronic components, except printed circuit boards, shall be commercially available, easily accessible, replaceable and individually removable using conventional electronics repair methods. All electronic assemblies shall meet or exceed IPC 610A workmanship standards.

Added 4/14/14

Each pixel shall have a device attached to the printed circuit board (PCB) to hold and protect the LEDs. These devices shall:

10. Hold the LEDs perpendicular to the display modules within 0.5 degree,
11. Prevent the LEDs from being crushed or bent during handling,
12. Protect the LEDs from damage when the display module is laid on the front surface (the side that the LED lamps are located),
13. Not put any stress on the LEDs due to differentials of expansion and contraction between the device and the LEDs over the herein specified temperature range,
14. Not become loose or fall off during handling or due to vibrations,
15. Not block airflow over the leads of the LEDs,
16. Securely hold each LED while allowing a gap between the device and a minimum of 95% of the body of each LED for airflow,
17. Not block the light output of the LEDs at the required viewing angle,
18. Be black in color to maximize contrast.

The LEDs shall be protected from the outside environmental conditions, including moisture, snow, ice, wind, dust, dirt and UV rays.

Printed Circuit Board (PCB) design shall be such that components may be removed and replaced without damage to boards, traces or tracks.

Only FR-4 0.062 inch minimum thickness material shall be used. Inter component wiring shall be copper clad track having a minimum weight of 2 ounces per square foot with adequate cross section for current to be carried. Jumper wires will not be permitted, except from plated-through holes to component. The maximum number of jumper wires allowed per circuit board is two.

All printed circuit boards (PCBs), except for the power supply PCBs, UPS PCBs, modem PCBs and sign controller PCBs, shall be completely conformal coated with a silicone resin conformal coat.

All PCBs shall be finished with a solder mask and a component identifier silk screen.

Capacitors

The DC and AC voltage ratings as well as the dissipation factor of a capacitor shall exceed the worst case design parameters of the circuitry by 50%.

A capacitor which can be damaged by shock or vibration shall be supported mechanically by a clamp or fastener.

Capacitor encasements shall be resistant to cracking, peeling and discoloration.

Resistors

Any resistor shall not be operated in excess of 50% of its power rating.

Added 4/14/14

Semiconductor Devices

All transistors, integrated circuits, and diodes shall be a standard type listed by EIA and clearly identifiable.

Connectors

All PCB edge connectors and cable connectors, except for those found in the power supply, UPS, modem and sign controller, shall be base plated with nickel and finished with 30 micro-inches of gold.

Mechanical Components

All external screws, nuts, and locking washers shall be stainless steel. No self-tapping external screws shall be used. All parts shall be made of corrosion resistant materials, such as plastic, stainless steel or aluminum. All materials used in construction shall be resistant to fungus growth and moisture deterioration. Dissimilar metals shall be separated by an inert dielectric material.

Main Power Supply and Energy Distribution

The sign and its controller shall be designed for use on the following:

Power line Voltage - 120/240 VAC Nominal, single-phase power, 40 amperes per leg - the system shall operate within a voltage range of 95VAC to 135VAC.

Frequency – 60Hz +/- 3Hz

Under normal operation, the drop in voltage between no load and full load of the sign and its controller shall not exceed 10% of the nominal voltage. The system shall be protected by transient suppression devices including, MOVS, RIS and spark gap arrestor.

The system shall report any power failures to the main controller when system power returns.

Power protection shall be provided by a thermal magnetic circuit breaker associated with a 5 mA ground fault circuit interruption (GFI) device. A GFI device shall protect all service outlets.

The sign shall have a 40 A two-pole (common trip) main, 120/240 VAC, single phase, four wire load center with 20 circuit capability. Each circuit in the sign shall be powered from a separate circuit breaker. The power cables shall be as required by the NEC for acceptable voltage drop to supply AC power to the sign. The power required for sign operation shall not exceed 7000 watts for the sign housing to include fans, heaters, sign controller, communication equipment and all pixels illuminated at 100% brightness.

Two conduits shall connect the controller cabinet with the walk-in sign display; one for power and one for communications, unless communications between the two is by optical fiber.

Added 4/14/14

The TMDMS manufacturer shall provide two earth ground lugs that are electrically bonded to the TMDMS housing. Lugs shall be installed near the lower left and lower right corners of the TMDMS housing's rear wall. The TMDMS installation contractor shall provide the balance of materials and services needed to properly earth ground the TMDMS to all four ground rods at each site.

The sign and shall be equipped with surge suppression circuitry for AC power conductors and external RS-232 data lines to protect them from electrical spikes and transients. The presence of power transients or electromagnetic fields, including those created by any components of the system, shall have no deleterious effect on the performance of the system.

The system shall not conduct or radiate signals which will adversely affect other electrical or electronic equipment including, but not limited to, other control systems, data processing equipment, audio, radio and industrial equipment.

Surge Protection

The system power shall be protected by two (2) stages of transient voltage suppression devices including MOVS and spark gap arrestor. Tripping of each stage (or both if tripped simultaneously) of the surge protection shall cause the sign controller to report the error condition to the DMS remote monitoring software.

DMS Power Supplies

TMDMS shall be provided with redundant DC power supplies. These shall be rated for a minimum of 50% spare capacity over that required to light every pixel on a line to full intensity, and shall automatically pick up the load if one unit fails, while sending an error indication to the TMDMS controller. All electrical components operating on more than 24 V shall be UL listed.

The power supplies shall be continuously monitored for proper operation by the sign controller. If the voltage drops below its nominal operating value, an error message shall be generated and transmitted to the DMS Client software, or laptop computer on site at local control box location automatically.

Display Modules

Display modules consisting of nominal 18" high characters shall be assembled to form the specified full matrix message configuration. These circuit boards shall be designed and constructed to allow a single service technician to troubleshoot, isolate, remove, and replace these boards with minimal impact to the overall operation of the sign.

All LED boards shall be fully interchangeable and not require any address switches or adjustment when interchanged or placed in service. Module addressing, where required, shall be accomplished in the connector. The DMS Manufacturer shall document all LED testing for color so that replacement LED boards shall match existing amber color.

Added 4/14/14

Pixel status and diagnostics shall include string failure, pixel failure and failed pixel location (line, module, row and column numbers). Replacement of a complete display module shall be possible using only simple hand tools. Interconnection of modules shall be through connectors only. All connectors shall be keyed to preclude improper hookups.

The display modules shall be approximately ¾" behind the lens panel assembly.

LED and Pixel Characteristics

Each pixel shall be a maximum of 1-3/8" in diameter. The LEDs in each pixel shall be clustered to maximize long range visibility. The average light intensity of the LEDs in each pixel shall be 3 candela minimum. All pixels in the sign shall have equal color and on-axis intensity. All pixels shall have a minimum on-axis intensity of 40 candela @ 20 mA forward current, with an overbright capability of 60 cd.

All pixels in all signs in this project, including the spare parts, shall have equal color and on-axis intensity. The pixel strings shall be powered from a regulated DC power source and the LED current shall be maintained at the LED manufacturer's specified nominal operating current to maximize life of the pixel. The failure of an LED in one string within a pixel shall not affect the operation of any other string or pixel. Pixel power drawn from the DC supplies shall not exceed 1.5 W per pixel, including the driving circuitry.

The LEDs shall be individually mounted directly to a printed circuit board and shall be easily replaceable and individually removable using conventional electronics repair methods.

The LEDs shall be protected from the outside environmental conditions, including, but not limited to, moisture, snow, ice, wind, dust, dirt, and UV rays.

TMDMS pixels shall be constructed with discrete LEDs manufactured by the Toshiba Corporation or Agilent Technologies (formerly known as Hewlett-Packard). Substitutes will not be accepted. Discrete LEDs shall conform to the following specifications:

- LED's shall be non-tinted, non-diffused, high-intensity, solid-state lamps that utilize AlInGaP semiconductor technology.
- LED lenses shall be fabricated from UV light resistant epoxy.
- The LED lens diameter shall be 0.2 inches (5 mm).
- LEDs shall emit amber (yellow-orange) light that has a peak wavelength of 590 $\pm$ 4 nm.
- LEDs shall be obtained from a one-bin luminous intensity sort.
- LEDs shall have a minimum half-power viewing angle of 15°.

Added 4/14/14

- LED package style shall be through-hole flush-mount; LED's with standoffs and surface mount LED's will not be accepted.

- All LED's used in all TMDMS provided for this contract shall be from the same manufacturer and have the same part number.

The sign shall have a minimum intensity of 9,200 cd/m2.

All LED display modules, as well as the LED pixel boards and driver circuit boards, shall be identical and interchangeable throughout the TMDMS. LED arrays shall not share a circuit board with the display drive electronics but shall be easily connected and disconnected from the driver board using plugs, sockets, and simple hand tools while excluding soldering operations.

The state of the LEDs (full on, or off) in each pixel of the sign shall be read by the sign controller when it is polled or when a message is downloaded from the DMS Client software, existing ATMS software, or laptop computer on site at local control box location, and shall allow the DMS Client software or laptop computer on site at local control box location show the actual message that is visibly displayed on the sign in a WYSIWYG format, including any full-out or fully stuck on pixels.

All printed circuit boards, except the LED circuit board, shall be conformal coated. The LED board shall be conformal coated except at the pixels. All printed circuit boards, including the LED circuit board, shall have a solder mask and a component identifier silk screen. The display modules shall be assembled in a full matrix configuration.

LED intensity shall be automatically adjusted to match ambient lighting conditions. This automatic control shall be provided with an override operated through the TMDMS controller communications channel.

Front face panels shall provide a high-contrast background for the TMDMS display matrix. The aluminum portion of each panel shall be painted black and shall contain a circular or square opening for each LED pixel. Openings shall be large enough to not block any portion of the LED-viewing angle.

The front panel shall be heated to prevent fogging and condensation. A minimum eight watt-per-foot, self-regulating, heat tape shall be provided along the bottom of the message area, between the glazing and the display modules. The TMDMS controller shall control the heat tape. All heat tape terminal blocks shall be covered for safety.

Structural Requirements

Walk-in TMDMS Display Cabinet

The TMDMS display cabinet shall allow replacement of any display component from the walkway within the sign, excluding the sign display cover. The removal of any display module shall not reduce the structural integrity of the walk-in cabinet.

Added 4/14/14

The maximum weight of the TMDMS display and walk-in enclosure shall not exceed 4000 lb. and shall conform to the structural loading capabilities of the sign structure. Dimensions of the TMDMS walk-in enclosure shall not exceed thirty one feet long by nine feet high by three feet wide (nominal dimensions).

The walk-in housing dimensions and total weight shall be as shown in this specification or in the plans. The walk-in housing shall protect all internal components from rain, ice, dust, and corrosion in accordance with NEMA enclosure Type 3R standards as described in NEMA Standards Publication 2501997, Enclosures for Electrical Equipment (1000 Volts Maximum).

The sign housing shall be engineered and P.E. certified to 2001 AASHTO and NCHRP Report 411 specifications for AASHTO basic wind speeds. The sign housing shall also be engineered and P.E. certified to withstand group loading combinations as outlined in 2001 AASHTO including: sign weight, repair personnel and equipment, ice and wind loads, and shall also meet strength requirements for truck-induced gusts as specified in NCHRP Report 412. The sign housing shall be engineered to withstand snow loading (40 PSF) for applicable geographical regions.

The internal structural members shall be extruded aluminum and shall accommodate both display module mounting and air distribution. They shall retain the display modules in a manner to facilitate easy and rapid removal of each display module without disturbing adjacent display modules.

The external fascia panels shall be extruded aluminum and shall be designed to keep heat conduction to a minimum between the exterior surfaces and the interior components. They shall incorporate provisions for retaining and sealing the modular lens panels and have a closed cell resilient gasket. They shall be finished with a matte black, KYNAR 500, or approved equal, and be removable from within the main sign housing. The external fascia perimeter panels shall be a minimum of 12” wide. The external fascia panels shall be thermally isolated from the rest of the sign housing. There shall be a minimum amount of metal contact between the external fascia panels and the rest of the sign housing.

The lens panel assembly shall be modular in design, interchangeable without misalignment of the lens panel and the LED pixels and removable from within the main sign housing.

The lens panel aluminum mask shall be 0.040” minimum thickness and panel interiors contain 0.236-inch-polycarbonate sheeting. It shall be perforated to provide an aperture for each pixel on the display modules. Each aperture shall be as small as possible, without blocking the LED light output at the required viewing angle.

The lens panel clear glazing shall be 90% UV opaque, non-breakable, polycarbonate GE LEXAN XL, ¼” minimum thickness and clear in color shall be laminated to the inside surface of the lens panel aluminum mask using an acrylic foam tape joining system, 3M Scotch VHB, or approved equal, to form the lens panel assembly.

The face shall be finished with a matte black, factory applied PVDF resin. All other exterior and all interior surfaces shall be a natural aluminum mill finish. No painted surfaces will be allowed.

Added 4/14/14

Inside the sign housing, all 120 VAC service lines shall be independently protected by a thermal magnetic circuit breaker at the housing entry point. All 120 VAC wiring shall be located in conduit, pull boxes, raceways or control cabinets. No 120 VAC wiring shall be exposed to the inside or outside of the sign housing. The sign housing shall not be considered as a raceway or control cabinet.

The bottom panel of the housing shall have a minimum of four drain holes, with replaceable drain filter plug inserts.

A three-point lockable aluminum access door shall be provided at the end of the housing as shown in the plans to enable easy access to the walk-in housing. This access door shall be 6'-8" X 2'-0" minimum. The door shall have a handle-operated locking mechanism, closed cell neoprene gasket and a stainless steel hinge. The locking mechanism shall be a heavy-duty, industrial-strength, three-point, dead bolt, center-case lock with a zinc finish. There shall be a handle on both the inside and the outside of the door. Handles shall be heavy-duty**,** industrial-strength with a zinc finish on the inside handle and a chrome plated finish on the outside handle. The outside handle shall be pad-lockable. Included in the door assembly shall be a device to hold the door open at 90 degrees.

For moving and installation purposes, multiple steel lifting eyebolts shall be attached to the top of the TMDMS housing. Eyebolts shall attach directly to the TMDMS housing structural frame and shall be installed at the TMDMS factory. All eyebolt-mounting points shall be sealed to prevent water from entering the TMDMS housing. Lifting eyebolts, as well as the housing frame, shall be designed so that the TMDMS can be shipped and handled without damage or undue stress being applied to the housing prior to or during TMDMS installation on its support structure.

The sign housing shall have a continuous 18-inch wide walkway extending the full length of the sign. The walkway shall be made of 1/8-inch, diamond tread, 6061-T6 or 3003-H22 aluminum. All edges of the walkway grating shall be finished to eliminate sharp edges or protrusions. The walkway shall be capable of supporting a total load of 1000 lb. within any 10-ft section of the walkway.

The sign housing shall be a minimum of 30 inches wide to allow adequate room inside the sign housing for maintenance personnel. There shall be 18 inches of clear area between all equipment along the entire length of the sign housing from the 18-inch walkway, and upwards 6 feet.

The sign shall be designed and constructed so as to present a clean and neat appearance. Poor quality work shall be cause for rejection of the sign. The equipment within the sign housing shall be protected from moisture, dust, dirt and corrosion. The sign shall be constructed of aluminum alloy 3003-H14, 5052-H32, or an approved equal which shall not be less than 1/8 inch thick. Framing structural members shall be made of aluminum alloy 6061-T6, 6063-T5, or approved equal.

Added 4/14/14

All welding shall be by an inert gas process in accordance with the American Welding Society (AWS) Standards, ANSI/AWS D1.2-97. The LED TMDMS manufacturer's welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the 1997 ANSI/AWS D1.2-97 Structural Welding Code for Aluminum.

The sign enclosures shall be capable of withstanding wind loadings of 120 mph without permanent deformation.

The performance of the signs shall not be impaired due to continuous vibration caused by wind, traffic or other factors. This includes the visibility and legibility of the display.

The ventilation system shall be a positive-pressure, filtered, forced-air system which cools both the display modules and the sign housing interior. The sign housing shall have at least two exhaust ports. Each exhaust port shall be filtered and protected by an aluminum hood assembly.

The ventilation system shall have a minimum of two fans. Air shall be drawn into the sign housing through hoods near the top of the housing, and then filtered before reaching the fan units. There shall be one aluminum hood assembly and one inlet filter for each fan.

The filters shall be 1" thick, permanent, reusable, filters. These filters shall be easily removable from within the sign housing without the use of tools. Each sign shall include a complete set of replacement filters.

All duct work that impedes access to any sign components shall be easily removable, without tools, for servicing of these components. Ductwork shall be 0.040 in minimum thickness aluminum and shall be designed for minimal pressure drops throughout the system.

Multiple temperature sensors shall activate the ventilation system. There shall be a minimum of one sensor located near the middle of the sign, at the top of the display area. There shall be an additional temperature sensor located to accurately measure the ambient temperature outside the sign housing. The temperature sensors shall have an accuracy of +/- 3°F. or better and a range from -40 to +155°F or greater.

The temperatures from the sensors shall be continuously measured and monitored by the sign controller. A temperature reading greater than a user selectable critical temperature shall cause the sign to go to blank and the TMDMS controller shall report this error message to the central controller.

The ventilation system shall be equipped with a manual override timer to provide ventilation for service personnel. The timer will have a maximum on time of 1 hour.

The LED modules and electronic equipment shall be protected by a fail-safe, back-up fan control system in the event of an electronic fan control failure or shutdown of the sign controller.

Added 4/14/14

The sign housing shall be furnished with a minimum of four florescent lights equipped with cold weather ballasts. The lamps shall be spaced evenly above the walkway and shall be fitted with protective guards. The light switch shall be located near the door and shall include a timer to turn off the lights after a specified time period.

The sign housing shall be equipped with two 15 amp 120V (+/- 10%) grounded GFCI protected duplex electrical receptacles to accommodate inspection and maintenance requirements. One of these receptacles shall be located at each end of the sign housing. Additionally, the sign housing shall be equipped with sufficient and readily available power source in order to accommodate a fiber optic modem and all other necessary communications equipment required to transmit data from the sign to nearest controller cabinet with fiber optic communications for the backbone. The sign housing and display panel shall be designed to minimize any visible internal light from the outside of the DMS when the internal DMS lighting is on during nighttime maintenance activities.

An effective, field-proven defogging and anti-condensation system shall be incorporated into the overall functionality of the sign. The face shall be heated to prevent fogging, frost and condensation.

A humidity sensor shall be provided and monitored by the sign controller from zero percent to 100 percent relative humidity in 1 percent or fewer increments. The sensor shall operate and survive from 0 percent to 100 percent relative humidity. The sensor shall have an accuracy that is better than +/- five percent relative humidity.

The sign controller shall read the internal temperature sensors, external ambient temperature sensor and the humidity sensor. The sign controller shall use these readings in an algorithm that turns on the heater and/or the fans at the appropriate times to reduce both frost on the face of the sign and condensation on the display modules and other electronic circuitry.

Baseboard heaters shall be included in the sign housing. These heaters shall be capable of remote start up in anticipation of winter field service.

The interior of the sign shall include a fold-down shelf for a laptop computer.

Sign Controller

The sign controller shall include a minimum of two (2) serial communications I/O ports; one (1) RS-232, one (1) RS-485 and one (1) Ethernet port.

The sign controller shall be programmed to receive NTCIP-compliant sign control commands from the central controller (DMS client software) or laptop computer, transmit NTCIP-compliant responses as requested to the central controller (DMS client software or existing ATMS) or laptop computer, monitor sign and message status and control sign operation and message displays.

The controller will have power-up and auto-restart capabilities with a programmable default message (including a blank message) when recovering from a power off condition.

Added 4/14/14

The sign controller shall be programmed to receive sign control commands from the master controller, transmit responses as requested to the master controller and control sign operation and message displays.

The sign controller shall be able to receive and send messages and data via IEEE 802.3 (Ethernet), fiber optic modem, and cellular CDPD, CDMA or GSM/GPRS. Transmission speed shall be a minimum of 9.6 kbps. A test pattern shall be provided in the DMS controller.

The sign controller shall be designed for fail-safe prevention of improper information display in the case of a system malfunction. Failure of any sign shall not affect operation of any other sign in the system. The sign controller shall consist, but not be limited to, the following:

Local control panel status indicators, including:

8. Power on/off
9. Communication status with the electronics in the walk-in housing
10. Sign display power supply status
11. Controller address
12. Power supply module
13. Central processor module
14. Input/output circuits

The sign controller shall have power-up and auto-restart capabilities with automatic sign blanking when recovering from a power-off condition. A watch-dog circuit shall be utilized to provide automatic shut down of the sign in the event of power or sign controller failure.

Connections from the controller shall be accomplished via industry standard, keyed type connectors with a retaining mechanism.

The sign controller shall communicate with the display modules via the system interface circuit consisting of data bus drivers and line address decoders. Communication and control lines between the sign controller and the system interface circuits shall be surge protected.

The sign controller shall be controlled from the DMS client software, existing ATMS software or the laptop computer, which shall specify the appropriate display. The sign controller and its software shall perform the following functions:

7. Display a message, including:
8. Static messages
9. Flashing messages
10. Alternating messages
11. Double brush stroke messages for maximum legibility
12. Full-Matrix type displays

Added 4/14/14

It shall be possible to separately vary the flashing and alternating frequency. The flashing frequency shall vary between one-half and five seconds in one tenth second increments. The alternating frequency shall vary between one-half and five seconds in one-tenth second increments.

It shall be possible to flash any character or set of characters in a static or alternating message. In the case of alternating message, the flashing period shall be a submultiple of the alternating on time it is associated with.

The sign controller shall report errors and failures, including, but not limited to:

Data transmission error
Receipt of invalid data
Communications failure recovery
AC power failure
Power recovery
Pixel status
Fan status
Temperature status
Power Supply status

The sign controller shall issue an SNMP trap under the following conditions:

Power Supply Failure – when the AC power supply at a DMS has failed.
Power Restoration - whenever it detects restoration of AC power at the sign controller.
Temperature Limit – Whenever internal DMS temperature initially exceeds a programmed safety limit. A new trap will not be issued until the temperature once again falls below the safety limit and then exceeds it.
Door Open – Whenever the door of the DMS housing or the door of the controller cabinet is opened.

Message and status monitoring:

The sign controller shall transmit a return message to the DMS client software and existing ATMS software whenever it receives a valid request for status. The return message shall contain the following:

Address of the sign controller
Actual message that is visibly displayed on the sign on an individual pixel basis
Current sign illumination level
Error and failure reports
Temperature readings
Power supply operational status
Origin of display message transmission (laptop, manual, central, etc.)
Beacon status (for possible future enhancement)
Uninterruptible power supply status

Added 4/14/14

The sign controller shall blank any message displayed in the event of power or sign controller failure.

The sign shall normally display single stroke (5 X 7) characters, compressed (4 X 7), expanded (6 X 7) or double-stroke (7 X 7) character fonts. Each font shall be fully customizable, and modifications to a font may be downloaded to the sign controller from the DMS client software and existing ATMS software or laptop computer at any time without any software or hardware modifications. The sign shall be capable of displaying a different font and character spacing on each line.

The sign controller shall monitor the photocell circuits in the sign and convert the measured light intensity into the desired pixel brightness. The photo circuit readings shall be correlated with a brightness table in the sign controller. The brightness table shall have a minimum of 255 brightness levels. Automatic adjustment of the LED driving waveform duty cycle shall occur in small enough increments so that brightness of the sign changes smoothly, with no perceivable brightness change between adjacent levels. The brightness levels shall be adjustable from the DMS client software.

The operational status of each pixel in the sign shall be automatically tested once a day and tested when a pixel test is requested from the DMS client software and existing ATMS software or laptop computer. A list of defective pixels shall then be transmitted to the DMS client software and existing ATMS software or laptop computer and logged into the log file, listing pixel status, module number, column number and pixel number. This pixel status test shall distinguish the difference between full out and fully stuck on pixels. This test shall not affect the displayed message for more than 0.5 seconds.

When the sign controller is polled and when a message is downloaded from the DMS client software and existing ATMS software or laptop computer, each pixel in the sign shall be read and its current state for the current displayed message, and shall be returned to the DMS client software and existing ATMS software to show either on a laptop computer or the controller itself, the actual message that is visibly displayed on the sign on an individual pixel basis in a WYSIWYG format.

The operational status of the fans shall have the ability to be automatically tested once a day and tested on command from the DMS client software and existing ATMS software or laptop computer. Any failure shall cause an error message to be sent to the DMS client software, existing ATMS software or laptop computer when the sign controller is polled by the DMS client software, existing ATMS software or laptop computer.

Added 4/14/14

Temperature sensors shall be continuously measured and monitored by the sign controller. A temperature greater than a user selectable critical temperature shall cause the sign message to go to blank and an error message shall be sent to the DMS client software and existing ATMS software or laptop computer when the sign controller is polled by the DMS client software, existing ATMS software or laptop computer. This user selectable critical temperature shall be capable of being changed by the DMS client software, existing ATMS software (if available) or laptop computer. The DMS client software and existing ATMS software (if available) and laptop computers shall have the ability to read all temperature measurements from the sign controller. When the sign reaches an internal temperature of 130° F, it shall cut the LED intensity to half of its normal brightness to keep the sign from reaching the critical temperature and shutting down.

When the display time of a message has expired, the controller shall set the sign to another pre-programmed message. A sign is considered to be neutral when the sign is blank.

In the event of a communications failure with the DMS client software or existing ATMS software, the sign controller shall set the sign to neutral after a user-defined number of minutes (1 to 60) unless communications have been restored within this period. This function shall apply only when the sign controller is in the Master Control mode.

All LED module power supplies shall be continuously monitored by the sign controller. A low voltage reading shall cause an error message to be sent to the DMS client software, existing ATMS software or laptop computer when the sign controller is polled by the DMS client software, existing ATMS software or laptop computer.

There shall be no perceivable flicker or ghosting of the pixels during sign erasure and writing periods.

Message additions, deletions and changes in the sign controller shall be made from either the DMS client software, existing ATMS software or the laptop computer.

In the event of an AC power loss, all non-volatile memory shall be retained for a minimum of 30 days. AC power failure shall cause the sign controller to notify the DMS client software and existing ATMS software and display an error message on the DMS client software and existing ATMS software CRT. For cellular operation, the sign controller shall immediately access the modem to notify the DMS client software and existing ATMS of the AC power failure.

Failure of any sign shall not affect the operation of any other sign in the system.

The sign controller internal time clock shall ensure that a message is taken down at the correct time, even in the event of communications loss.

The sign controller shall maintain its internal clock during power outages of less than 4 hours and display the proper message when power is restored.

The sign controller shall be able to put a self-updating time, temperature and/or date display on the sign.

Added 4/14/14

Ethernet Switch

A managed ethernet switch shall be supplied for the purposes of controller communication. The ethernet switch provided shall be per the special provision for ETHERNET SWITCH and per the chart shown in the plans.

Flashing Beacons parapgraph removed (not required)

Construction Requirements

Sign construction and installation shall be coordinated with the Engineer. TMDMS shall be transported and erected in a manner recommended by the manufacturer, providing a minimum clearance of 17.5 ft. above the pavement and a horizontal appearance to motorists once fully installed as shown on the Plans.

Signage shall be mounted level and will not follow the camber of walkways or truss members.

Technical Assistance

The DMS manufacturer's technical representative shall provide on-site technical assistance in following areas:

5. Sign to structure installation
6. Controller cabinet installation
7. Sign housing to ground control cabinet cable termination
8. Initial sign turn on and stand-alone test

The initial powering up of the sign(s) shall not be executed without the permission of the DMS manufacturer's technical representative.

Any special or proprietary cables shall be provided by the DMS Manufacturer to the installation contractor.

Testing

The Contractor shall certify in writing to the Engineer that each TMDMS installation is fully compliant with the NTCIP standards named in the Materials section of this Special Provision. All mandatory objects and the optional objects mentioned above under Materials shall be certified for each sign and provided to the Department. In addition, following installation, the Contractor shall perform a site test of each sign, demonstrating the functionality and performance required in the Materials section of this Special Provision to the Engineer. The Contractor shall give the Engineer a minimum of two weeks notice before performing the site test.

Added 4/14/14

Testing Requirements

The Department has the right to require performance testing of materials and equipment not previously tested and approved. If technical data are not considered adequate for approval, samples may be requested for testing.

The DMS Manufacturer shall provide five (5) copies of all factory acceptance tests, stand-alone, system test and 90 day test procedures and data forms for the Department's approval at least 60 calendar days prior to the day the tests are to begin. The test procedures shall include the sequence in which the tests will be conducted. The test procedures shall have the Department's approval prior to submission of equipment for tests.

The DMS Manufacturer shall perform the factory acceptance tests, stand-alone and system test. The DMS Manufacturer shall furnish data forms containing all of the data taken, as well as quantitative results for all tests. The data forms shall be signed by an authorized representative (company official) of the equipment manufacturer. At least one (1) copy of the data forms shall be sent to the Department within 14 days of the test's conclusion.

The Department reserves the right to have a representative to witness all tests. The results of each test shall be compared with the requirements specified herein. Failure to conform to the requirements of any test shall be counted as a defect, and the equipment shall be subject to rejection by the Department. Rejected equipment may be offered again for a retest, provided that all non-compliances have been corrected and retested by the DMS Manufacturer and evidence thereof submitted to the Department.

Each of the tests on all or one type of equipment must be completed within five (5) working days of each other. Any delays in performing all these tests may result in the DMS Manufacturer paying the additional costs of providing the Department's representatives for the additional testing time.

Final inspection and acceptance of equipment shall be made after installation at the designated location as shown on the installation plans.

The DMS Manufacturer shall be responsible for providing the test fixtures and test instruments for all the tests.

The Stand-Alone and System Tests are separate tests, however, they may be performed by the DMS Manufacturer during the same visit.

Consequences of Test Failures: If any unit fails to pass its test, the unit shall be corrected or another unit substituted in its place and the test successfully repeated.

If a unit has been modified as a result of a test failure, a report shall be prepared and delivered to the Department prior to shipment of the unit. The report shall describe the nature of the failure and the corrective action taken.

If a failure pattern develops, the Department may direct that design and construction modifications be made to all units at no additional cost or extension of the contract period.

Added 4/14/14

Factory Acceptance Tests

The TMDMS Manufacturer shall be responsible for conducting demonstration tests on all units at a TMDMS's Manufacturer's facility. These tests shall be performed on each unit supplied. The Department shall be notified a minimum of 30 calendar days before the start of tests. At a minimum, all equipment shall have passed the following individual tests:

- Examination of Product: Each TMDMS unit shall be examined carefully to verify that the materials, design, construction, markings and quality of work comply with the requirements of these project specifications.

- Continuity Tests: The wiring shall be checked to determine conformance with the requirements of the appropriate paragraphs in these project specifications.

- Operational Test: Each TMDMS unit shall be operated long enough to permit equipment temperature stabilization, and to check and record an adequate number of performance characteristics to ensure compliance with the requirements of these project specifications.

- NTCIP Test: A NTCIP test shall be performed at the TMDMS Manufacturer's facility. The Department may elect to perform and/or witness this test. The specifics of this factory acceptance test shall be proposed by the TMDMS Manufacturer to the Department for approval.

- Stand-Alone Tests: The TMDMS Manufacturer shall conduct an approved stand-alone test of the equipment installation at the field site. The test shall, as a minimum, exercise all stand-alone (non-network) functional operations of the field equipment with all of the equipment installed as per the contract documents.

Approved data forms shall be completed and turned over to the Department as the basis for review and rejection or acceptance. At least 30 working days notice shall be given prior to all tests to permit the Department to observe each test.

System Tests

After the installation of the TMDMS system is completed and the successful completion of the System Test, the TMDMS system shall be subjected to one continuous 72-hour full operating test prior to a 90 day test period. The test shall consist primarily of exercising all control, monitor and communications functions of the field equipment by the central management software.

The 90 days test period shall commence on the first day after the successful completion of the approved 72-hour continuous full operating test period.

During the 90 days test period, downtime, due to mechanical, electrical and/or other malfunctions, shall not exceed five (5) working days. The Engineer may extend the 90 days test period by a number of days equal to the downtime in excess of five (5) working days.

Added 4/14/14

The Engineer will furnish the TMDMS vendor with a letter of approval stating the first day of the 90 days test period.

Maintenance Services

The installation contractor shall provide complete maintenance services for the entire TMDMS assembly until the final acceptance. All labor, travel, replacement parts and associated costs necessary to maintain the TMDMS assembly shall be included in the contract at no additional cost to the Department.

The installation contractor shall correct all failures in the TMDMS assembly within 48 hours of notification from the Department until final acceptance. A failure of a sign installation shall be defined as the inability of the sign to function as per these specifications. A failure shall also be defined as the sign becoming unreadable or illegible as determined by the Department.

Final System Acceptance

Final system acceptance will be defined as when all work and materials provided have been furnished and completely installed by the TMDMS Manufacturer, and all parts of the work have been approved and accepted by the Department and the Dynamic Message Sign System has been operated continuously and successfully for 90 calendar days with no more than 5 calendar days downtime due to mechanical, electrical and/or other malfunctions, as specified herein.

The warranty period, as specified in herein, will begin upon final acceptance.

Operator's Manuals

A manual containing a general description and detailed operating and installation instructions shall be provided for each different type or model of equipment. One (1) copy of the manual shall be provided and kept in the sign cabinet. An additional ten (10) copies of the manual shall be submitted to the Department for each model of equipment. An additional copy of the manual shall be submitted to the Department on CD for each model of equipment. The manual shall include the following information:

5. A general description of the equipment including all information necessary to describe the basic use or function of the system components. This shall include a general block diagram presentation of the equipment. Where auxiliary equipment is required, tabular charts shall be included, listing such equipment. These charts shall include the nomenclature physical and electrical characteristics and functions of the auxiliary equipment unless such information is contained elsewhere in an associated manual. In the latter case, a reference shall be made to the location of the information pertaining to the auxiliary equipment.

Added 4/14/14

6. The theory of operation of the system components in a clear, concise manner supported by simplified schematics, logic, data flow diagrams, one-function diagrams, etc. Timing and waveform diagrams and voltage levels shall be shown as required. A logical development shall be used starting with a system block level and proceeding to a circuit analysis. Circuit analysis shall be detailed whenever circuits are not normally found in standard textbooks. The application of new theoretical concepts shall be fully described. Where the design allows operation in a number of different modes, an operational description of each mode shall be included.

7. In simple, clear language, the routine of operation, from necessary preparations for placing the equipment into operation, to securing the equipment after operation. This section shall contain appropriate illustrations, with the sequence of operations presented in tabular form wherever feasible. This section shall also contain a list of applicable test instruments, aids and tools required in the performance of necessary measurements and technique of each system component. In addition, set-up test, and calibration procedures shall be described.

8. Schematic diagrams shall be complete and accurate as required to supplement the text material and to allow the books to be a self-contained technical information source. Maximum size of these diagrams should be limited to allow their use in close proximity of the equipment, in the classroom, etc., part reference symbols, test voltages, waveforms, and other aids to understanding of the circuit's function shall be included on the diagrams. Test voltages, waveforms, and other aids to understanding of the circuit's function may be shown on both the simplified schematics and other drawings (as required in the above sections) on theory of operation, or maintenance or on the schematic diagrams required for this section. The overall scope of information shall not be less, however, than that stated for the schematic diagrams.

Software Manuals

The TMDMS Manufacturer shall provide manuals and data for the computer software system and components thereof. One (1) copy of the manual shall be provided and kept in the sign cabinet. Ten (10) additional copies of the manual shall be submitted to the Department for each version of software. One (1) copy of the manual shall be provided on CD. As software is upgraded, updated versions of the manual shall be provided. This submittal shall include the following:

6. Software user's manuals shall be supplied. Include instructions for performing a backup of all software and message libraries.
7. Two (2) copies of source programs, for master and sign controller software, shall be provided on CD-ROM. The Department shall have the right to duplicate the sign controller software as needed for use in controlling signs under its' jurisdiction.
8. The TMDMS Manufacturer's NTCIP MIB (Management Information Base) shall be provided to the Department.
9. Warranty information.
10. Preventive maintenance and maintenance information.

Added 4/14/14

Maintenance Manuals

A manual containing a general description and detailed maintenance instructions shall be provided for each different type or model of equipment. One (1) copy of the manual shall be provided and kept in the sign cabinet. An additional ten (10) copies of the manual shall be submitted to the Department for each model of equipment. One (1) copy of the manual shall be provided on CD. The manual shall include the following information:

5. The manufacturer's recommended procedures and checks necessary for preventive maintenance. This shall be specified for pre-operation, weekly, monthly, quarterly, semi-annual, annual, and "as required" checks as necessary to assure reliable equipment operation. Specifications, including tolerances, for all electrical, mechanical, and other applicable measurement, adjustments, or both, shall be listed. The TMDMS Manufacturer shall provide the Department with a sample preventive maintenance schedule.

6. Data necessary for isolation and repair of failures or malfunctions, assuming the maintenance technicians to be capable of analytical reasoning using the information provided above. Accuracies, limits, and tolerances for all electrical, physical or other applicable measurements shall be described. General instructions shall be included for disassembly, overhaul, and reassembly, including shop specifications or performance requirements.

7. Detailed instructions shall be given only where failure to follow special procedures would result in damage to the equipment, improper operation, or danger to operating or maintenance personnel.

8. The parts list shall contain all information required to describe the characteristics of the individual parts, as required for identification. It shall include a list of all equipment within a group and list of all assemblies, subassemblies, and replacement parts of units. The tabular arrangement shall be in alphanumerical order of the schematic reference symbols and shall give the associated description, manufacturer's name, and part number. A table of contents or some other convenient means, e.g., appropriate grouping, shall be provided for the purpose of identifying major components, assemblies, etc.

As-Built Documentation

The TMDMS Manufacturer shall provide to the Department the following documentation of the complete installed equipment prior to final payment. Sufficient documentation shall be provided to reflect "as-built" conditions and to facilitate operation, maintenance, modification, and expansion of the system or any of its individual components. Manufacturer supplied documentation which covers the intent of this requirement may be used, subject to the approval of the Department:

Added 4/14/14

The TMDMS Manufacturer shall prepare and submit the following detailed drawings for each sign:

- TMDMS character set as detailed herein,
- All non-catalog or custom-made components,
- Sign housing assembly details, including the component location details and a layout of all the display elements, complete with dimensions,
- Sign housing structural details, including member details, support mechanism details required for installation of the TMDMS onto the sign truss, welding details, and miscellaneous hardware details; complete with dimensions and sizes,
- Sign mounting bracket structural details, including miscellaneous members and hardware required to attach the TMDMS to the sign truss; complete with dimensions and sizes, and
- Wiring schematics.

Final documentation shall reflect all field changes and software modifications and shall be provided before final payment is made.

The TMDMS Manufacturer shall coordinate and take the lead on this effort with the installation contractor.

This documentation shall include drawings of conduit layouts, cable diagrams, wiring lists, cabinet layouts, wiring diagrams and schematics for all elements of the communications system. This shall also include detailed drawings identifying by cable type, color code and function, the routing of all conductors (pairs) in the communications system.

Four (4) copies of each As-Built installation shall be delivered to the Department with one complete copy to be placed in the equipment cabinet at each TMDMS location. Drawings left in the TMDMS shall be attached to the door with stainless steel fasteners and protected from weather with a waterproof enclosure.

Added 4/14/14

Warranty

The Contractor shall warranty all materials and workmanship including labor for a period of two years after the completion and acceptance of the installation, unless other warranty requirements prevail. Any parts or equipment found to be defective and/or determined to be a failure in design, materials and workmanship during the warranty period shall be replaced free of charge. The warranty period shall begin when the Contractor completes all construction obligations related to this item and when the components for this item have been accepted, which shall be documented as the final completion date in the construction status report. This warranty shall include repair and/or replacement of all failed components via a factory authorized depot repair service. All items sent to the depot for repair shall be returned within two weeks of the date of receipt at the facility. The depot location shall be in the United States. Repairs shall not require more than two weeks from date of receipt and the provider of the warranty shall be responsible for all return shipping costs. The depot maintainer designated for each component shall be authorized by the original manufacturer to supply this service. A warranty certificate shall be supplied for each component from the designated depot repair site indicating the start and end dates of the warranty. The certificate shall be supplied at the conclusion of the system acceptance test and shall be for a minimum of two years after that point. The certificate shall name the Department as the recipient of the service. Company contact information and warranty dates should be clearly shown on the warranty certificate. The Department shall have the right to transfer this service to other private parties who may be contracted to perform overall maintenance of the facility.

Method of Measurement

Truss mounted changeable message sign shall be measured for payment each per TMTMDMS complete, in place, tested to assure all functionality and performance required above, and accepted by the Engineer.

Basis of Payment

Payment will be made at the unit price for each TRUSS MOUNTED LED DYNAMIC MESSAGE SIGN which shall include all equipment, material, documentation, testing and labor detailed in the contract documents for this bid item.

CCTV CABINET

The proposed cabinet for camera interface shall be mounted to existing or new poles as shown in the plans in a manner that is acceptable to the engineer.

The cabinet shall be an enclosure of weatherproof, stainless steel of adequate size per the required equipment at the respective location shown in the plans. One 15 amp breaker shall be provided for the incoming 120V power line

In general, the cabinet shall contain the following equipment: surge arrestor, terminal enclosure of adequate size and 2 duplex receptacles.

Added 4/14/14

The proposed cabinet shall vent to provide air flow.

At locations designated in the plans a 480V to 120V transformer will be required to be installed reduce the incoming power supply to the camera. The transformer shall be paid for under the respective pay item.

This work shall be paid for at the contract unit price for at the contract unit cost EACH for CCTV CABINET and no additional compensation will be allowed.

CCTV CAMERA

This work shall consist of the installation of an integrated Closed-Circuit Television (CCTV) Dome Camera Assembly and CAT. 5 ethernet cable at the locations shown in the plans.

In order to maintain compatibility with existing network cameras, the camera provided in this contract shall be the AXIS Dome Network Camera, Model No. Q6032-E PTZ or the pre-approved equivalent.

The camera shall be capable of receiving power over ethernet injector.

Where it is shown in the plans that a camera shall be mounted to a combination mast-arm pole and assembly, it shall be mounted to the mast pole 6 inches below the luminaire truss arm. The contractor shall supply the necessary mounting hardware, per the approval of the engineer, for mounting the camera on mast arm poles and shall be considered as included in this pay item.

The contractor shall ensure that a clear viewing path is accessible away from the intersection in all 4 directions. The mast pole shall not inhibit the view along either street.

Ethernet Cable - The contractor shall supply and install an outdoor rated CAT 5 Ethernet Cable that is per the manufacturer's specifications. The ethernet cable shall be installed from the camera interface cabinet to the camera location. The ethernet cable will not be paid for separately but considered included in associated pay items.

ETHERNET SWITCH

This work shall include supplying and installing ethernet switches at locations designated in the plans for the purpose of interfacing with fiber optic network(s). The ethernet switches provided for this contract shall be of the managed type or the unmanaged type as they are noted in the plans per location.

The managed ethernet switches shall be Comtrol RocketLinx ES8509-XT or the pre-approved equivalent.

Managed ethernet switches shall be equipped with Comtrol SFP Single-Mode 10KM 1000BASE-GLX (Extended Temperature) transceivers or the pre-approved equivalent.

Added 4/14/14

The unmanaged ethernet switches shall be Comtrol RocketLinx ES8108F of the single mode version or the preapproved equivalent.

All fiber optic jumpers necessary to connect SFP's to the fiber optic distribution enclosure shall be included in this pay item.

This work shall be paid for per the contract unit cost EACH for ETHERNET SWITCH and shall include installation complete to the intended function. No additional compensation will be allowed.

VIDEO VEHICLE DETECTION, 4 CAMERAS/ VIDEO SYSTEM DETECTION PROCESSOR

This work shall consist of upgrading the existing Iteris video detection systems in place at the locations designated in the plans.

At each location designated in the plans upgrading the video detection system shall consist of the replacement of all video cameras (4) and the detection processor (1).

Video Cameras – The video cameras supplied by the contractor shall be of the latest Iteris Vantage camera in order to remain compatible with the local existing video detection systems in place.

Video Processor – The processor supplied by the contractor shall be of the latest Iteris Vantage Edge processor in order to remain compatible with the local existing video detection systems in place.

The Vantage Edge processor shall at a minimum consist of 2 Edge cards for processing, a TS2 IM module for interfacing with the controller, and a Vantage Edge Connect module.

The operator of the video detection system shall be able to program, interface, and view live video from a remote location via the ethernet connection to the traffic signal cabinet.

This work shall be paid for at the contract unit cost EACH for VIDEO VEHICLE DETECTI+
ON, 4 CAMERAS and VIDEO SYSTEM DETECTION PROCESSOR and shall include removal and disposal of the existing video detection components. It shall also include complete installation and wiring of the new video detection components to the complete, intended function. No additional compensation will be allowed.

Added 4/14/14

FIBER OPTIC CABLE IN CONDUIT, NO. 62.5/125, MULTIMODE 12 FIBERS, SINGLE-MODE 12 FIBERS-OR- FIBER OPTIC CABLE IN CONDUIT, NO. 62.5/125, SINGLE-MODE 12 FIBERS-OR- FIBER OPTIC CABLE IN CONDUIT, NO. 62.5/125, SINGLE MODE 12 FIBERS

This work shall be in accordance with Sections 801, 864, 871, and 1076 of the Standard Specifications except as modified herein.

Each cable shall be clearly labeled in each cabinet utilizing a durable computer generated label. The label shall contain information in regards to the location where the cable is going to or coming from.

All fibers shall be spliced and terminated at the terminal enclosure. Fusion splicing of a pre-manufactured pigtail to the cable will be considered as an acceptable method of terminating the fibers in the distribution enclosure.

All terminated fibers shall be clearly labeled. Fibers not being used shall be labeled “spare”.

Splicing of fibers will not be allowed between cabinets.

All ancillary components, required to complete the fiber optic cable plant, including but not limited to, moisture and water sealants, cable caps, fan-out kits, weather-proof splice kits, boots, cable trays, splice enclosures, etc., shall be supplied under this pay item and will not be paid for separately. These items shall be submitted to the Department for approval.

The fiber optic cable shall be clearly marked in each handhole and cabinet with a brightly colored (orange or yellow) weather resistant label securely attached to the cable.

The Contractor shall provide and install a 12 Ga., stranded (XLP, TYPE USE), insulated tracer cable in all conduits that contain fiber optic cable. This work shall be done at the same time the fiber optic cable is pulled. The tracer cable will be paid for under the respective pay item.

Materials. The single-mode, multi-mode fiber optic cable shall incorporate a loose, buffer-tube design. The cable shall conform to the requirements of RUS 7 CFR1755.900 (PE-90) for a single sheathed, non-armored cable, and shall be new, unused and of current design and manufacture. The number of fibers in each cable shall be as specified on the plans.

The cable shall utilize either a water blocking gel or a dry block tape.

Added 4/14/14

Experience Requirements.

Personnel involved in the installation, splicing and testing of the fiber optic cables shall meet the following requirements:

A minimum of three (3) years experience in the installation of fiber optic cables, including splicing, terminating and testing single mode fibers.

Install two systems where fiber optic cables are outdoors in conduit and where the systems have been in continuous satisfactory operation for at least two years. The Contractor shall submit as proof, photographs or other supporting documents, and the names, addresses and telephone numbers of the operating personnel who can be contacted regarding the installed fiber optic systems.

One fiber optic cable system (which may be one of the two in the preceding paragraph), which the Contractor can arrange for demonstration to the Department representatives and the Engineer.

Installers shall be familiar with the cable manufacturer's recommended procedures for installing the cable. This shall include knowledge of splicing procedures for and equipment being used on this project and knowledge of all hardware such as breakout (furcation) kits and splice closures. The Contractor shall submit documented procedures to the Engineer for approval and to be used by Construction inspectors.

Personnel involved in testing shall have been trained by the manufacturer of the fiber optic cable test equipment to be used, in fiber optic cable testing procedures. Proof of this training shall be submitted to the Engineer for approval. In addition, the Contractor shall submit documentation of the testing procedures for approval by the Engineer.

Installation in Conduit.

During cable pulling operations, the Contractor shall ensure that the minimum bending of the cable is maintained during the unreeling and pulling operations. Entry guide chutes shall be used to guide the cable into the handhole conduit ports. Lubricating compound shall be used to minimize friction. Corner rollers (wheels), if used, shall not have radii less than the minimum installation-bending radius of the cable. A series array of smaller wheels can be used for accomplishing the bend if the cable manufacturers specifically approve the array.

The pulling tension shall be continuously measured and shall not be allowed to exceed the maximum tension specified by the manufacturer of the cable. Fuse links and breaks can be used to ensure that the cable tensile strength is not exceeded. The pulling system shall have an audible alarm that sounds whenever a pre-selected tension level is reached. Tension levels shall be recorded continuously and shall be given to the Engineer upon request.

Added 4/14/14

The cable shall be pulled into the conduit as a single component, absorbing the pulling force in all tension elements. The central strength member and Aramid yarn shall be attached directly to the pulling eye during cable pulling. "Basket grip" or "Chinese-finger type" attachments, which only attach to the cable's outer jacket, shall not be permitted. A breakaway swivel, rated at 95% of the cable manufacturer's approved maximum tensile loading, shall be used on all pulls. When simultaneously pulling fiber optic cable with other cables, separate grooved rollers shall be used for each cable.

Splicing of cable will not be allowed between cabinets.

Removed Splice Specification

Operation and Maintenance Documentation:

After the fiber optic cable plant has been installed, two (2) complete sets of Operation and Maintenance Documentation shall be provided. The documentation shall, as a minimum, include the following:

- Complete and accurate as-built diagrams showing the entire fiber optic cable plant including locations of all splices.
- Final copies of all approved test procedures.
- Complete performance data of the cable plant showing the losses at each terminal connector.
- Complete parts list including names of vendors.

Testing Requirements:

Testing shall be in accordance with Article 801.13

The Contractor shall submit detailed test procedures for approval by the Engineer. All continuous fiber runs shall be tested bi-directionally at both 1310 nm and 1550 nm with a power meter and optical source. For testing, intermediate breakout fibers may be concatenated and tested end-to-end. Any discrepancies between the measured results and these specifications will be resolved to the satisfaction of the Engineer.

The Contractor shall provide the date, time and location of any tests required by this specification to the Engineer at least 5 days before performing the test. Upon completion of the cable installation, splicing, and termination, the Contractor shall test all fibers in each link for continuity and attenuation. The test procedure shall be as follows:

A Certified Technician utilizing an Optical Source/Power Meter shall conduct the testing. The Technician is directed to conduct the test using the standard operating procedures defined by the manufacturer of the test equipment. All fibers installed shall be tested in both directions.

Added 4/14/14

At the completion of the test, the Contractor shall provide two copies of documentation of the test results to the Engineer. The test documentation shall be bound and shall include the following:

Cable & Fiber Identification:

Cable ID
Cable Location - beginning and end point
Fiber ID, including tube and fiber color
Operator Name
Date & Time
Setup Parameters
Wavelength
Pulse width (OTDR)
Refractory index (OTDR)
Range (OTDR)
Scale (OTDR)
Setup Option chosen to pass OTDR “dead zone”

Test Results:

Optical Source/Power Meter

Total Attenuation
Attenuation (dB/km)

These results shall be provided in tabular form. The following shall be the criteria for the acceptance of the cable:

The test results shall show that the dB/km loss does not exceed +3% of the factory test or 1% of the cable's published production loss. However, no event shall exceed 0.10 dB. If any event is detected above 0.10 dB, the Contractor shall replace or repair the proposed fiber and/or fusion splice and connector including that event point.

The total dB loss of the cable, less events, shall not exceed the manufacturer's production specifications as follows: 0.5 dB/km at both 1310 and 1550 nm.

If the total loss exceeds these specifications, the Contractor shall replace or repair that cable run at the Contractor's expense, both labor and materials. Elevated attenuation due to exceeding the pulling tension during installation shall require the replacement of the cable run at the Contractor's expense, including labor and materials.

The Contractor shall label the destination of each trunk cable onto the cable in each handhole and termination panel.

Added 4/14/14

Remove - Slack Storage of Fiber Optic Cables.

Basis of Payment: This work will be paid for at the contract unit price per foot for FIBER OPTIC CABLE of the type specified and shall be payment in full for all labor, equipment, and materials required to provide, install, terminate, splice, and test the fiber optic cable described above, complete.

Added 4/14/14