



CALL NO. 100

CONTRACT ID. 081030

CHRISTIAN COUNTY

FED/STATE PROJECT NUMBER DPR 0171(004)

LETTING DATE: October 31, 2008

Sealed Bids will be received in the Division of Construction Procurement and/or the Auditorium located on the 1st floor of the Transportation Cabinet Office Building until 10:00 AM EASTERN DAYLIGHT TIME October 31, 2008. Bids will be publicly opened and read at 10:00 AM EASTERN DAYLIGHT TIME.

DBE CERTIFICATION REQUIRED

REQUIRED BID PROPOSAL GUARANTY: Not less than 5% of the total bid.

(Check guaranty submitted: Cashier's Check Certified Check Bid Bond)

BID BONDS WHEN SUBMITTED WILL BE RETAINED WITH THE PROPOSAL

DBE General Plan Included

BID

PROPOSAL ISSUED TO: _____

SPECIMEN

Address

City

State

Zip

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PART I
SCOPE OF WORK

CONTRACT ID - 081030

ADMINISTRATIVE DISTRICT - 02

PROJECT(S) IDENTIFICATION AND DESCRIPTION:

COUNTY - CHRISTIAN

PCN - DE02400240830

DPR 0171(004)

HOPKINSVILLE-TENNESSEE STATE LINE ROAD (I-24) HITS INSTALLATION AT VARIOUS LOCATIONS ON
I-24, KY 911 AND US 41A. INTELLIGENT TRANSPORTATION SYSTEMS. SYP NO. 02-00192.00.

GEOGRAPHIC COORDINATES LATITUDE 36^53'00" LONGITUDE 87^28'00"

COMPLETION DATE(S):

COMPLETION DATE - January 01, 2010

APPLIES TO ENTIRE CONTRACT

CONTRACT NOTES

PROPOSAL ADDENDA

All addenda to this proposal must be incorporated into the proposal when the bid is submitted to the Kentucky Department of Highways. Failure to use the correct and most recent bid sheet(s) may result in the bid being rejected.

BID SUBMITTAL

Bidder must use the Department's Highway Bid Program available on the Internet web site of the Department of Highways, Division of Construction Procurement. (www.transportation.ky.gov/contract)

The Bidder must download the bid items created from the web site to prepare a bid proposal for submission to the Department. The bidder must insert the completed bid item sheets printed from the Program into the bidder's proposal and submit with the disk created by said program.

JOINT VENTURE BIDDING

Joint Venture bidding is permissible. However, both companies MUST purchase a bidding proposal. Either proposal may be submitted but must contain the company names and signatures of both parties where required. A joint bid bond of 5% may be submitted for both companies or each company may submit a separate bond of 5%.

UNDERGROUND FACILITY DAMAGE PROTECTION

The contractor is advised that the Underground Facility Damage Protection Act of 1994, became law January 1, 1995. It is the contractor's responsibility to determine the impact of the act regarding this project, and take all steps necessary to be in compliance with the provision of the act.

CONTRACT DBE GOAL

The Disadvantaged Business Enterprise (DBE) goal established for this contract is 19% of the total value of the contract.

The contractor shall exercise all necessary and reasonable steps to ensure that Disadvantaged Business Enterprises participate in at least the percent of the contract as set forth above as goals for this contract.

FEDERAL CONTRACT NOTES

The Kentucky Department of Highways, in accordance with the Regulations of the United States Department of Transportation 23 CFR 635.112 (h), hereby notifies all bidders that failure by a bidder to comply with all applicable sections of the current Kentucky Standard Specifications, including, but not limited to the following, may result in a bid not being considered responsive and thus not eligible to be considered for award:

102.02 Current Capacity Rating
102.08 Irregular Proposals
102.09 Proposal Guaranty

102.10 Delivery of Proposals
102.14 Disqualification of Bidders

CIVIL RIGHTS ACT OF 1964

The Kentucky Department of Highways, in accordance with the provisions of Title VI of the Civil Rights Act of 1964 (78 Stat. 252) and the Regulations of the Federal Department of Transportation (49 C.F.R., Part 21), issued pursuant to such Act, hereby notifies all bidders that it will affirmatively insure that the contract entered into pursuant to this advertisement will be awarded to the lowest responsible bidder without discrimination on the ground of race, color, or national origin.

NOTICE TO ALL BIDDERS

To report bid rigging activities call: 1-800-424-9071.

The U.S. Department of Transportation (DOT) operates the above toll-free "hotline" Monday through Friday, 8:00 a.m. to 5:00 p.m. eastern time. Anyone with knowledge of possible bid rigging, bidder collusion, or other fraudulent activities should use the "hotline" to report such activities.

The "hotline" is part of the DOT's continuing effort to identify and investigate highway construction contract fraud and abuse and is operated under the direction of the DOT Inspector General. All information will be treated confidentially and caller anonymity will be respected.

FHWA 1273

The requirements of Paragraph VI of FHWA 1273 does not apply to projects with a total cost of less than \$1,000,000.00.

SECOND TIER SUBCONTRACTS

Second Tier subcontracts on federally assisted projects shall be permitted. However, in the case of DBE's, second tier subcontracts will only be permitted where the other subcontractor is also a DBE. All second tier subcontracts shall have the consent of both the Contractor and the Engineer.

DISADVANTAGED BUSINESS ENTERPRISE PROGRAM

It is the policy of the Kentucky Transportation Cabinet ("the Cabinet") that Disadvantaged Business Enterprises ("DBE") shall have the opportunity to participate in the performance of highway construction projects financed in whole or in part by Federal Funds in order to create a level playing field for all businesses who wish to contract with the Cabinet. To that end, the Cabinet will comply with the regulations found in 49 CFR Part 26, and the definitions and requirements contained therein shall be adopted as if set out verbatim herein.

The Cabinet, contractors, subcontractors, and sub-recipients shall not discriminate on the basis of race, color, national origin, or sex in the performance of work performed pursuant to Cabinet contracts. The contractor shall carry out applicable requirements of 49 CFR 26 in the award and administration of federally assisted highway construction projects. The contractor will include this provision in all its subcontracts and supply agreements pertaining to contracts with the Cabinet.

Failure by the contractor to carry out these requirements is a material breach of its contract with the Cabinet, which may result in the termination of the contract or such other remedy as the Cabinet deems necessary.

OBLIGATION OF CONTRACTORS

Each contractor prequalified to perform work on Cabinet projects shall designate and make known to the Cabinet a liaison officer who is assigned the responsibility of effectively administering and promoting an active program for utilization of DBEs.

If a formal goal has not been designated for the contract, all contractors are encouraged to consider DBEs for subcontract work as well as for the supply of material and services needed to perform this work.

Contractors are encouraged to use the services of banks owned and controlled by minorities and women.

CERTIFICATION OF CONTRACT GOAL

Contractors shall include the following certification in bids for projects for which a DBE goal has been established. **BIDS SUBMITTED WHICH DO NOT INCLUDE CERTIFICATION OF DBE PARTICIPATION WILL NOT BE READ PUBLICLY.** These bids will not be considered for award by the Cabinet and they will be returned to the bidder.

“The bidder certifies that it has secured participation by Disadvantaged Business Enterprises (“DBE”) in the amount of ____ percent of the total value of this contract and that the DBE participation is in compliance with the requirements of 49 CFR 26 and the policies of the Kentucky Transportation Cabinet pertaining to the DBE Program.”

The certification statement is located on the last page of this proposal. All contractors must certify their DBE participation on that page. DBEs utilized in achieving the DBE goal must be certified and prequalified for the work items at the time the bid is submitted.

DBE PARTICIPATION PLAN

All bidders are encouraged to submit their General DBE Participation Plan with their bid on the official form. Lowest responsive bidders whose bid packages include DBE Participation Plans may be awarded the contract at the next Awards Committee meeting provided that the DBE goal is met. The DBE Participation Plan shall include the following:

1. Name and address of DBE Subcontractor(s) and/or supplier(s) intended to be used in the proposed project;
2. Description of the work each is to perform including the work item , unit, quantity, unit price and total amount of the work to be performed by the individual DBE;
3. The dollar value of each proposed DBE subcontract and the percentage of total project contract value this represents. DBE participation may be counted as follows:
 - a) If DBE suppliers and manufactures assume actual and contractual responsibility, the dollar value of materials to be furnished will be counted toward the goal as follows:
 - The entire expenditure paid to a DBE manufacturer;
 - 60 percent of expenditures to DBE suppliers that are not manufacturers provided the supplier is a regular dealer in the product involved. A regular dealer must be engaged in, as its principal business and in its own name, the sale of products to the public, maintain an inventory and own and operate distribution equipment; and
 - the amount of fees or commissions charged by the DBE firms for a bona fide service, such as professional, technical, consultant, or managerial services and assistance in the procurement of essential personnel,

facilities, equipment, materials, supplies, delivery of materials and supplies or for furnishing bonds, or insurance, providing such fees or commissions are determined to be reasonable and customary.

- b) The dollar value of services provided by DBEs such as quality control testing, equipment repair and maintenance, engineering, staking, etc.;
 - c) The dollar value of joint ventures. DBE credit for joint ventures will be limited to the dollar amount of the work actually performed by the DBE in the joint venture;
4. Written and signed documentation of the bidder's commitment to use a DBE contractor whose participation is being utilized to meet the DBE goal; and
 5. Written and signed confirmation from the DBE that it is participating in the contract as provided in the prime contractor's commitment.

The apparent low bidder who does not submit a General DBE Participation Plan with the bid shall submit it within 10 calendar days after receipt of notification that they are the apparent low bidder. The project will not be considered for award prior to submission and approval of the apparent low bidder's DBE Participation Plan.

Detailed DBE Participation Plan forms will be included in the Contractor Package presented to successful bidders following the awarding of the project. The Detailed DBE Participation Plan must be completed and returned to Contract Procurement in accordance with Cabinet policy. A copy of the blank estimate will be included with the Detailed DBE Participation Plan to list sequence items by PCN (Project Control Number).

Changes to DBE Participation Plans must be approved by the Cabinet. The Cabinet may consider extenuating circumstances including, but not limited to, changes in the nature or scope of the project, the inability or unwillingness of a DBE to perform the work in accordance with the bid, and/or other circumstances beyond the control of the prime contractor.

CONSIDERATION OF GOOD FAITH EFFORTS REQUESTS

If the DBE participation submitted in the bid by the apparent lowest responsive bidder does not meet or exceed the DBE contract goal, the apparent lowest responsive bidder must submit a Good Faith Effort Package to satisfy the Cabinet that sufficient good faith efforts were made to meet the contract goals prior to submission of the bid. Efforts to increase the goal after bid submission will not be considered in justifying the good faith effort, unless the contractor can show that the proposed DBE was solicited prior to the letting date. DBEs utilized in achieving the DBE goal must be certified and prequalified for the work items at the time the bid is submitted. One complete set and nine (9) copies of this information must be received in the office of the Division of Contract Procurement no later than 12:00 noon of the tenth calendar day after receipt of notification that they are the apparent low bidder.

Where the information submitted includes repetitious solicitation letters it will be acceptable to submit a sample representative letter along with a distribution list of the firms solicited. Documentation of DBE quotations shall be a part of the good faith effort submittal as necessary to demonstrate compliance with the factors listed below which the Cabinet considers in judging good faith efforts. This documentation may include written subcontractors' quotations, telephone log notations of verbal quotations, or other types of quotation documentation.

The Good Faith Effort Package shall include, but may not be limited to information showing evidence of the following:

1. Whether the bidder attended any pre-bid meetings that were scheduled by the Cabinet to inform DBEs of subcontracting opportunities;
2. Whether the bidder provided solicitations through all reasonable and available means;
3. Whether the bidder provided written notice to all DBEs listed in the DBE directory at the time of the letting who are prequalified in the areas of work that the bidder will be subcontracting;
4. Whether the bidder followed up initial solicitations of interest by contacting DBEs to determine with certainty whether they were interested. If a reasonable amount of DBEs within the targeted districts do not provide an intent to quote or no DBEs are prequalified in the subcontracted areas, the bidder must notify the DBE Liaison in the Office of Minority Affairs to give notification of the bidder's inability to get DBE quotes;
5. Whether the bidder selected portions of the work to be performed by DBEs in order to increase the likelihood of meeting the contract goals. This includes, where appropriate, breaking out contract work items into economically feasible units to facilitate DBE participation, even when the prime contractor might otherwise perform these work items with its own forces;
6. Whether the bidder provided interested DBEs with adequate and timely information about the plans, specifications, and requirements of the contract;
7. Whether the bidder negotiated in good faith with interested DBEs not rejecting them as unqualified without sound reasons based on a thorough investigation of their capabilities. Any rejection should be so noted in writing with a description as to why an agreement could not be reached;
8. Whether quotations were received from interested DBE firms but were rejected as unacceptable without sound reasons why the quotations were considered unacceptable. The fact that the DBE firm's quotation for the work is not the lowest quotation received will not in itself be considered as a sound reason for rejecting the quotation as unacceptable. The fact that the bidder has the ability and/or desire to perform the contract work with its own forces will not be considered a sound reason for rejecting a DBE quote. Nothing in this provision shall be construed to require the bidder to accept unreasonable quotes in order to satisfy DBE goals;
9. Whether the bidder specifically negotiated with subcontractors to assume part of the responsibility to meet the contract DBE goal when the work to be subcontracted includes potential DBE participation;

10. Whether the bidder made any efforts and/or offered assistance to interested DBEs in obtaining the necessary equipment, supplies, materials, insurance and/or bonding to satisfy the work requirements of the bid proposal; and
11. Any other evidence that the bidder submits which may show that the bidder has made reasonable good faith efforts to include DBE participation.

FAILURE TO MEET GOOD FAITH REQUIREMENT

Where the apparent lowest responsive bidder fails to submit sufficient participation by DBE firms to meet the contract goal and upon a determination by the Good Faith Committee based upon the information submitted that the apparent lowest responsive bidder failed to make sufficient reasonable efforts to meet the contract goal, the bidder will be offered the opportunity to meet in person for administrative reconsideration. The bidder will be notified of the Committee's decision within 24 hours of its decision. The bidder will have 24 hours to request reconsideration of the Committee's decision. The reconsideration meeting will be held within two days of the receipt of a request by the bidder for reconsideration.

The request for reconsideration will be heard by the Office of the Secretary. The bidder will have the opportunity to present written documentation or argument concerning the issue of whether it met the goal or made an adequate good faith effort. The bidder will receive a written decision on the reconsideration explaining the basis for the finding that the bidder did or did not meet the goal or made adequate Good Faith efforts to do so.

The result of the reconsideration process is not administratively appealable to the Cabinet or to the United States Department of Transportation.

The Cabinet reserves the right to award the contract to the next lowest responsive bidder or to rebid the contract in the event that the contract is not awarded to the low bidder as the result of a failure to meet the good faith requirement.

SANCTIONS FOR FAILURE TO MEET DBE REQUIREMENTS OF THE PROJECT

Failure by the prime contractor to fulfill the DBE requirements of a project under contract or to demonstrate good faith efforts to meet the goal constitutes a breach of contract. When this occurs, the Cabinet will hold the prime contractor accountable, as would be the case with all other contract provisions. Therefore, the contractor's failure to carry out the DBE contract requirements shall constitute a breach of contract and as such the Cabinet reserves the right to exercise all administrative remedies at its disposal including, but not limited to the following:

- Disallow credit toward the DBE goal;
- Withholding progress payments;
- Withholding payment to the prime in an amount equal to the unmet portion of the contract goal; and/or
- Termination of the contract.

PROMPT PAYMENT

The prime contractor will be required to pay the DBE within seven (7) working days after he or she has received payment from the Kentucky Transportation Cabinet for work performed or materials furnished.

CONTRACTOR REPORTING

All contractors must keep detailed records and provide reports to the Cabinet on their progress in meeting the DBE requirement on any highway contract. These records may include, but shall not be limited to payroll, lease agreements, cancelled payroll checks, executed subcontracting agreements, etc. Prime contractors will be required to submit certified reports on monies paid to each DBE subcontractor or supplier utilized to meet a DBE goal.

Prime contractors will incorporate a requirement into DBE subcontracts, including supply contracts, that DBEs must provide to the Division of Construction, a copy of all checks received from the prime contractor within seven days of receipt of payment for work performed on Cabinet projects. Checks to DBE subcontractors must include the PCN number, estimate number, and the sequence and quantity.

DEFAULT OR DECERTIFICATION OF THE DBE

If the DBE subcontractor or supplier is decertified or defaults in the performance of its work, and the overall goal cannot be credited for the uncompleted work, the prime contractor may utilize a substitute DBE or elect to fulfill the DBE goal with another DBE on a different work item. If after exerting good faith effort in accordance with the Cabinet's Good Faith Effort policies and procedures, the prime contractor is unable to replace the DBE, then the unmet portion of the goal may be waived at the discretion of the Cabinet.

PROJECT TRAFFIC COORDINATOR (PTC)

This project is a significant project pursuant to section 112.03.12.

DGA BASE

The rate of application for DGA Base shall be estimated at 115 lbs/sy per inch of depth.

COMMONWEALTH OF KENTUCKY
TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS

CHRISTIAN COUNTY
HIGHWAY INFORMATION FOR
TRAVELING SERVICEPERSONS (HITS)

LETTING: OCTOBER 31, 2008
ITEM NUMBER: 2-192.00
PROJECT NUMBER:
DPR 0771 (004)

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PROJECT DESCRIPTION

GENERAL

This project includes furnishing and installing overhead VMS and WEB cameras on poles. This equipment will expand the traffic monitoring and advisory capabilities of the District 2 and the TOC.

This ITS Project complies with the requirements of 23 CFR 940. The ITS work to be performed is referenced in the current Kentucky Statewide ITS Architecture at Appendix B-77 and B-81 (Market Package Diagram for the Statewide TOC, and ATMS 06 Traffic Information Dissemination), and in the Statewide ITS Business Plan at Pages 26-29 (Dynamic Message Sign Deployment).

EQUIPMENT AND MATERIALS

All equipment and materials shall be new, free of defects and damage.

SPECIFICATIONS AND WORKMANSHIP

Unless otherwise specified, all work shall conform to the following:

- Kentucky Standard Specifications for Road and Bridge Construction, latest edition.
- FHWA, Manual on Uniform Traffic Control Devices, latest edition.
- National Electrical Code, latest edition.
- National Electric Safety Code, latest edition.
- KYTC Department of Highways Standard Drawings, current editions.
- KYTC Department of Highways Sepia Drawings, current editions.
- International Municipal Signal Association (IMSA) Specification No. 51-7, current edition.
- AASHTO, Roadside Design Guide, latest edition.

- AASHTO, Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, latest edition.
- Kentucky Transportation Cabinet, Department of Highways, Special Provisions: Special Provision 13 Crash Cushions

All work shall be performed in a neat and professional manner. The Contractor shall remove debris and trash from work areas during construction. The Contractor shall restore areas to original condition and clean up all debris after construction.

DAMAGE TO EXISTING FACILITIES

The Contractor shall be responsible for locating all underground utilities prior to excavation. The contractor shall repair damage caused to any public or private facilities at his expense. Utilities include but are not limited to telephone, power, water, gas, fiber optic cable, underground vaults, roadway lighting wiring, traffic signal wiring, and roadway drainage systems.

GROUNDING

Unless otherwise specified, ground wiring shall be solid bare copper 4 AWG and securely connected inside enclosures with copper clamp connectors. Nuts and washers securing the wire are not acceptable. All grounding shall be in compliance with the National Electric Code. Ground wires shall be exothermically welded to ground rods. Ground rod clamps are not acceptable. The following devices shall be grounded to an array of 10' X 1" copper coated steel ground rods:

- Model 334 and 336 Enclosures (two ground rods required)
- Camera Poles (one ground rods required)
- VMS and Truss (two ground rods required)

Each ground rod in an array shall have a 6' minimum separation.

The resistance to ground of each grounding system shall be less than 10 Ohms as measured with an AEMC Instruments Inc. clamp-on ground resistance meter or equivalent. Existing grounding systems shall be replaced if the resistance to ground is greater than 10 Ohms.

The Contractor shall leave all exothermic welds exposed for inspection by the Engineer before backfilling.

EQUIPMENT LIST

The contractor shall provide an equipment list in Microsoft Excel format to the Engineer containing the following information:

- Type of equipment
- Field location
- Make
- Model
- Serial number

- Date of purchase
- Manufacturer contact information
- Equipment vendor contact information (if different)
- Date of Installation
- Date warranty expires

This list shall be provided to the Division of Traffic Operations prior to burn-in testing.

WARRANTY

The Contractor shall provide a copy of all equipment warranty information to the Division of Traffic Operations. The Contractor shall provide documentation from the manufacturer that ownership of the warranty is transferred to the following:

Kentucky Transportation Cabinet
Division of Traffic Operations
200 Mero Street
Frankfort, KY 40622

TESTING

The Contractor shall demonstrate proper functioning of all devices at the field cabinets.

A 30 day equipment burn-in test will begin after each device is accepted. If a device fails during the 30 burn-in day test the Contractor shall repair or replace the device and demonstrate that the device is functioning at the field cabinet and a new 30 day burn-in test will begin for that device. Each device will be accepted after it has successfully completed its 30 day test.

SHOP DRAWINGS

All items that are used on this project shall have shop drawings sent to Traffic Operations for approval. All items shall be approved before purchase of said items.

AS-BUILT DRAWINGS

The Contractor, at the completion of the project, shall submit as-built drawings. As-built drawings shall be submitted in electronic format such as .pdf, .tiff, .dgn or other standard image format acceptable to the Engineer. As-built drawings may be scanned from marked up field plans or drawn in MicroStation. As-built drawings shall be scanned at a resolution that will allow them to be clearly legible on a computer display. As-built drawings shall include the exact location of all above ground equipment, underground conduit, wire, sensors and other equipment. Drawings shall indicate any changes to the design including changes to the numbers of conductors, wire gage, splices, additional conduit, etc. Conduit locations shall be drawn to scale or shall be dimensioned and referenced to permanent roadway features. Turns in conduit shall be referenced so that the conduit paths may be derived from the as-built drawings. Existing underground utilities shall be indicated on the drawings. Two copies of the drawings shall be submitted. One copy of the drawings shall be submitted to the Engineer. One copy of the drawings shall be submitted to the KYTC Division of Traffic Operations Design Services Branch. The Contractor shall correct any drawings that are deemed

unacceptable to the Engineer. As-built drawings shall be delivered prior to burn-in testing.

TRAFFIC CONTROL PLAN

**THIS PROJECT IS A FULLY CONTROLLED
ACCESS HIGHWAY**

TRAFFIC CONTROL GENERAL

Except as provided herein, traffic shall be maintained in accordance with the 2003 MUTCD, Standard Specifications and the Standard Drawings, current editions. Except for the roadway and traffic control bid items listed, all items of work necessary to maintain and control traffic will be paid at the lump sum bid price to "Maintain and Control Traffic".

Contrary to Section 106.01, traffic control devices used on this project may be new, or used in like new condition, at the beginning of the work. Maintain traffic control devices according to Section 112.

If requested by the Contractor, the speed limit in work areas may be reduced by 10 miles per hour and double fines for work zone speeding violations may be established. The extent of these areas within the project limits will be restricted to the proximity of actual work areas as determined by the Engineer. Signage for reduced speed limits and double fine work zones shall be furnished, relocated, and maintained by the Contractor.

TRAFFIC CONTROL PLANS

Proposed changes to the Traffic control plans shall be submitted to the Engineer two weeks prior to work in the area covered by the plan. This submittal shall consist of five copies of the plans for review and distribution. No work shall begin at any location until the traffic control plan has been approved by KYTC.

PROJECT PHASING & CONSTRUCTION PROCEDURES

No lane or shoulder closures shall be allowed during the following times:

- Between 12:00 noon Friday and 6:00 A.M. Tuesday when the holiday is observed on a Monday: New Year's Day, Memorial Day, Labor Day, and Christmas.
- Between 12:00 noon Thursday and 6:00 A.M. Monday when the holiday is observed on a Friday: Good Friday.

- Between 12:00 noon on the day before the holiday and 6:00 A.M. on the day following the holiday when the holiday is observed midweek: Independence Day.
- Between 12:00 noon on the day before Thanksgiving and 6:00 A.M. the following Monday.

Unless prohibited by the above notes, hours of permitted lane closures are as follows:

Single Lane Closure – KY 911 only

Sunday:	7pm to 7am
Monday:	7pm to 7am
Tuesday:	7pm to 7am
Wednesday:	7pm to 7am
Thursday:	7pm to 7am
Friday:	Prohibited
Saturday:	Prohibited

The Contractor shall maintain a minimum of two lanes in each direction at all times on the interstate roadways, one lane on entrance and exit ramps, and one lane in each direction on surface streets, except as noted, or upon approval of the Engineer. The clear lane width shall be 12 feet. Lane closures shall not exceed 1 mile in length. Multiple closures in the same direction of travel are not permitted. Shoulders used as temporary roadways shall be paved with asphalt mixtures for Leveling and Wedging as directed by the Engineer prior to opening to traffic. The Contractor shall provide additional traffic control or flaggers as directed by the Engineer.

DESCRIPTION

Procedure for Erecting Overhead Sign Supports. Erection of span type overhead supports shall be accomplished in such a manner that complete stoppage on all lanes of any directional roadway is not more than fifteen (15) minutes in any one (1) thirty (30) minute period. The work shall be done between the hours of 1:00 A.M. and 4:00 A.M.

Total road closures shall be accomplished by means of a rolling road block. Law enforcement officer(s) with patrol vehicle(s) shall be used to pace traffic. The patrol vehicles shall have high-rise flashing beacons to provide adequate visibility to approaching vehicles. When the Engineer deems appropriate, restrictions may be used to funnel traffic into fewer lanes at the work stoppage area. Where stoppages back up in the vicinity of freeway entrances, the Contractor shall place a flagman and appropriate signs on the ramps to stop traffic. When the Engineer deems appropriate, the Contractor shall erect and maintain "ROAD WORK AHEAD," "BE PREPARED TO STOP," and "STOP AHEAD" signs with flashing twelve inch (12") yellow traffic signal heads. These signs shall be illuminated during the night operation.

The Contractor shall advise the Engineer in writing in advance of all road/lane closures as follows:

- 48 hours notice on all lane closures
- 72 hours notice on total interstate roadway and ramp closures

If traffic should be stopped due to construction operations, and a school bus on an official run arrives on the scene, the Contractor shall make provisions for the passage of the bus as quickly as possible.

Night work is allowed on this project. The method of lighting will require written approval from the Engineer prior to its use.

TEMPORARY LANE CLOSURES

The lengths of additional lane closures shall be only that needed for actual operations, or as directed by the Engineer. Lane closures shall not exceed 1 mile in length. Multiple closures in the same direction of travel are not permitted.

FINES

In addition to Liquidated damages specified in Section 108.09, the following disincentives shall apply:

Single Lane Closure-KY 911 only

7pm to 7am (Sunday through Thursday)	No Cost
1 extra hour	\$1000
2 extra hours	\$2000
Additional hours	\$4000

Road Closure

0 to 15 Minutes	\$0.00
15 to 30 Minutes	\$1,000.00
30 to 45 Minutes	\$2,000.00
45 to 60 Minutes	\$4,000.00
Greater Than 60 Minutes	\$4,000.00 Per Hour or Fraction of Any Hour

Road closures shall be allowed only during the hours specified for Erecting Overhead Sign Supports.

All liquidated damages will be applied accumulatively.

All other applicable portions of Section 108 apply.

SIGNS

Additional traffic control signs in addition to normal lane closure signing detailed on the Standard Drawings may be required by the Engineer. Additional signs needed for lane closures may include, but are not limited to, dual mounted LEFT/RIGHT LANE CLOSED 1 MILE, LEFT/RIGHT LANE CLOSED 2 MILE, LEFT/RIGHT LANE

CLOSED 3 MILE, SLOWED/STOPPED TRAFFIC AHEAD. Signage for reduced speed limits and double fine work zones shall be furnished, relocated, and maintained by the Contractor.

Contrary to section 112, only long term signs (signs intended to be continuously in place for more than 3 days) will be measured for payment. Individual signs will be measured only once for payment, regardless of how many times they are set, reset, removed, and relocated during the duration of the project. Replacements for damaged signs or signs directed to be replaced by the Engineer due to poor legibility or reflectivity will not be measured for payment. Contrary to section 112, short term signs (signs intended to be left in place for 3 days or less) will not be measured for payment but will be incidental to Maintain and Control Traffic.

VARIABLE MESSAGE SIGNS

Provide variable message signs in advance of and within the project at locations to be determined by the Engineer. If work is in progress concurrently in both directions, provide additional variable message signs. Place variable message signs one mile in advance of the anticipated queue at each lane closure. As the actual queue lengthens and/or shortens relocate or provide additional variable message signs so that traffic has warning of slowed or stopped traffic at least one mile but not more than two miles before reaching the end of the actual queue. The locations designated may vary as the work progresses. The messages required to be provided shall be designated by the Engineer. In the event of damage or mechanical/electrical failure, the Contractor shall repair or replace the Variable Message Sign within 24 hours.

TRUCK MOUNTED ATTENUATORS

If traffic lanes are closed without the use of temporary barrier wall, use Truck Mounted Attenuators. Furnish and install Truck Mounted Attenuators in advance of all pavement removal areas and other work areas when workers are present less than 10 feet from traffic. If there is less than 500 feet between work sites, only a single TMA will be required at a location directed by the Engineer. The TMAs shall be located at the individual work sites and shall be moved as the work zone moves within the project limits. All details of the TMA installations are to be approved by the Engineer. Contrary to Special Provision 13 Crash Cushions, the Department will not take ownership of the TMAs. Truck Mounted Attenuators are incidental to Maintain and Control Traffic.

CONTRACTOR'S AND CONTRACTOR'S EMPLOYEE'S VEHICLES

Median crossovers will not be used at any time. All vehicles will change directions only at interchanges.

PAVEMENT MARKINGS

Remove or cover the lenses of raised pavement markers that do not conform to the traffic control scheme in use, or as directed by the Engineer. Lenses shall be replaced or uncovered before a closed lane is reopened to traffic. No direct payment will be made for removing and replacing or covering and uncovering the lenses, but shall be incidental to "Maintain and Control Traffic".

Temporary striping shall be in accordance with Section 112, except that:

- (1) Temporary Striping shall be 6" in width; and
- (2) If the contractor's operations or phasing requires temporary markings which must be subsequently removed from the ultimate pavement, an approved removable lane tape shall be used; and
- (3) Edge lines will be required for temporary striping; and
- (4) Temporary striping shall be in place before a lane is opened to traffic.
- (5) Use black mask removable lane tape to cover existing permanent striping that will be required to remain in place for subsequent phases or upon completion of the work.

Permanent striping shall be in accordance with Section 112, except that:

- (1) Striping shall be 6" in width; and
- (2) Temporary or Permanent striping shall be in place before a lane is opened to traffic; and
- (4) Permanent striping shall be Painted.

TRAFFIC COORDINATOR

The Contractor shall designate an employee to be traffic coordinator. The Traffic Coordinator shall inspect the project maintenance of traffic every day during the Contractor's operations and at any time a lane closure is in place. The Traffic Coordinator shall report all incidents throughout the work zone to the Engineer on the project. The Contractor shall furnish the name and telephone number where the Traffic Coordinator can be contacted at all times.

The Traffic Coordinator will arrange for personnel to inspect the traffic control, maintain the signing and devices, and relocate variable message boards as queue lengths change. The personnel will have access on the project to a radio or telephone to be used in case of emergencies or accidents.

COORDINATION OF WORK

The Contractor is advised that other projects may be in progress within or in the near vicinity of this project. The traffic control of those projects may affect this project and the traffic control of this project may affect those projects. The Contractor will coordinate the work on this project with the work of the other contractors. In case of conflict, the Engineer will determine the relative priority to give to work phasing on the various projects.

PAVEMENT EDGE DROP OFFS

Pavement edge drop-offs shall be protected by a lane or shoulder closure. Lane closures shall be protected with plastic drums, vertical panels, or barricades as shown on the Standard Drawings. Cones may be used for shoulder closures, but will not be allowed for lane closures.

Pavement edges that traffic is not expected to cross, except accidentally, will be treated as follows:

Less than 2 inches - No protection required. Warning signs should be placed in advance and throughout the drop-off area.

2 inches to 4 inches - Place plastic drums, vertical panels, or barricades every 50 feet. Wedge with asphalt mixture for leveling and wedging with a 1:1 or flatter slope in daylight hours, or 3:1 or flatter slope during nighttime hours, when work is not active in the drop-off area. Spacing for devices on tapered sections should be in accordance with the Manual on Uniform Traffic Control Devices, current edition.

Greater than four inches - positive separation or wedge with 3:1 or flatter slope needed. If there is five (5) feet or more distance between the edge of pavement and drop-off, then drums, panels, or barricades may be used. If the drop off is greater than twelve (12) inches, positive separation is strongly encouraged. If concrete barriers are used, special reflective devices or steady burn lights should be used for overnight installations.

For temporary conditions, drop-offs greater than four (4) inches may be protected with plastic drums, vertical panels or barricades for short distances during daylight hours while work is being done in the drop-off area.

SITE PREPARATION

DESCRIPTION

Site Preparation shall be performed in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Site Preparation shall include all materials required to access and protect the work area.

INSTALLATION

The Contractor shall coordinate with the Engineer prior to performing any site preparation work. This item includes excavation, guardrail removal, guardrail replacement, temporary ditch crossings, temporary barriers and clearing of debris and foliage. Salvaged materials may be used at the discretion of the Engineer. Site preparation shall be one per VMS sign location. There shall not be site preparation for

locations that have web cameras installed on existing signal poles and existing highmast. There will be a site preparation for the 80 foot pole at I-24 @ US 41A.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Site Preparation will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

CCTV CONTROL CABLE

DESCRIPTION

Furnish and install CCTV Control Cable in accordance with the plans, specifications and Standard Drawings.

MATERIALS

CCTV Control Cable shall be compatible with Web Camera Assembly. CCTV control cables shall be a composite cable consisting of one CAT 6 Cable and an appropriate number and size of copper conductors to meet the needs of the camera. Cable shall meet all applicable specifications of UL/NEC/CEC CATV or CM. Cable shall be flame resistant per UL 1581 Vertical Tray. All connectors, terminators, fittings, etc. are incidental to the cost of installing the CCTV control cable and no separate payment will be made.

INSTALLATION

CCTV Control Cable shall be of suitable length to allow installation between equipment without exceeding the minimum bend radius as specified by the manufacturer. Connectors shall be installed as necessary and shall match the connector interface requirements for the equipment being connected. Adapters are not acceptable.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

CCTV Control Cable will be measured for payment per unit linear foot. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

POLE BASE

DESCRIPTION

Furnish and install Pole Base in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Pole Base includes concrete, anchor bolts, reinforcing steel, and conduit within base. The Contractor shall submit to material testing at the discretion of the Engineer.

INSTALLATION

The Contractor shall stake all proposed pole base locations and obtain approval before excavation, the Traffic Engineer, District 2 will approve locations for all pole bases. The Contractor shall have utilities marked in the field prior to requesting approval. The Contractor shall allow two weeks to schedule the location approval. KYTC approval of field device location does not relieve the contractor from his responsibility to avoid utilities and repair any damage to buried infrastructure. The Contractor shall grade and re-seed all disturbed areas and restore the area to the satisfaction of the Engineer. Poles located behind guardrail shall have a minimum 5' spacing from edge of pole to face of guardrail. Otherwise, poles shall be located as according to the plans sheets or a minimum of 30' from all driving lanes. This item includes all excavation including any special equipment required to install the base in rock.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pole Base/Pole Base-High Mast will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

STEEL STRAIN POLE

DESCRIPTION

Steel strain pole shall be designed to support a web camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations.

MATERIALS

POLE MATERIALS

All materials and products shall be manufactured in the United States of America, and comply with ASTM or AASHTO specifications. Mill certifications shall be supplied as proof of compliance with the specifications.

POLE DESIGN

Pole design shall be in accordance with loading and allowable stress requirements of 2001 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" Fourth Edition. Loading shall be based on:

- basic wind speed of 90 mph

- 30 percent gust factor using
- 1.65 safety factor
- design life/recurrence interval of 50 years
- Fatigue importance factor category I.
- Design for galloping and truck-induced gust fatigue is not required for this structure.

All drawings and calculations shall be submitted in detail demonstrating compliance with the AASHTO Specification.

To avoid vortex shedding, the steel pole members shall have a taper of 0.14 in/ft or less. All structures shall be designed to natural wind gust conditions. The yearly mean wind speed for natural wind gusts will be assumed to be 11.2 per hour. Design for galloping and truck-induced gust fatigue is not required for this structure.

The pole top deflection shall not exceed one inch in a 30-mph (non-gust) wind. The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, at 5-ft. pole intervals/segments and at any other critical pole section. Design shall be based on wind loading from an Axis Network Dome Model 232D+ or approved equal.

Poles up to 50' in length shall be one-piece construction and shall conform to ASTM A595 Grade A with minimum yield strength of 55 ksi or ASTM A572 with minimum yield strength of 65 ksi. The shaft shall be hot dip galvanized.

POLE HAND HOLES

The pole hand hole opening shall be reinforced with a minimum 2-inch wide hot rolled steel rim. The nominal outside dimensions shall be at least 5 inches x 11 inches. There shall be a stop installed on the formed retaining strap of the handhole cover to stop this strap from free spinning when the handhole cover is put on the handhole. A suitable grounding lug shall be 180 degrees from handhole opening and the lug shall be accessible.

BASE PLATE

Base plates shall conform to ASTM A36 or A572 Grade 42. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar. Plates shall be hot dip galvanized per the requirements of the contract documents.

POLE ANCHOR BOLTS

Anchor bolts shall conform to the requirements of ASTM F1554 Grade 55. Each pole shall be furnished complete with galvanized anchor bolts and hardware. Each anchor bolt shall be furnished with three (3) nuts, 2 washers, lock washer, and leveling nut. The strength of the nuts shall equal or exceed the proof load of the bolts.

POLE WELDING

All welding shall be in accordance with Sections 1 through 8 of the AWS D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and shall be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic-particle inspected by the manufacturer. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected by the manufacturer.

INSTALLATION

POLE

Pole shall be installed in the correct orientation and plumb. Pole shall be grounded in accordance with the plans and specifications. Damaged galvanizing shall be repaired with a paint approved by the Engineer. Each pole shall have a permanent label on the outside listing the height, stringing tension, maximum deflection rate.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pole will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

POLE WITH LOWERING DEVICE

DESCRIPTION

Pole with lowering device shall be designed to support and lower/raise a CCTV camera, lens, housing, PTZ mechanism, cabling, connectors and other supporting field components without damage or causing degradation of camera operations. The lowering device and the pole are interdependent and thus, must be considered a single unit or system. The lowering device system shall consist of a pole, suspension contact unit, divided support arm, pole adapter for attachment to a pole top tenon, pole top junction box, and camera connection box. The lowering device to be furnished shall be the product of a manufacturer with a minimum of two years of experience in the manufacturing of such systems.

MATERIALS

LOWERING DEVICE

Lowering device shall be [MG]² Model CLDMG2, Camera Lowering Systems CDP series or approved equal.

SUSPENSION CONTACT UNIT

The suspension contact unit shall have a load capacity 200 lbs. with a 4 to 1 safety factor. There shall be a locking mechanism between the fixed and moveable components of the lowering device. The movable assembly shall have a latching mechanism with a minimum of two latches. This latching mechanism shall securely hold the device and its

mounted equipment. The latching mechanism shall operate by alternately raising and lowering the assembly using the winch and lowering cable. When latched, all weight shall be removed from the lowering cable. The fixed unit shall have a heavy duty cast tracking guide and means to allow latching in the same position each time. The contact unit housing shall be weatherproof with a gasket provided to seal the interior from dust and moisture.

The prefabricated components of the lift unit support system shall be designed to preclude the lifting cable from contacting the power or video cabling. The only cable permitted to move within the pole or lowering device during lowering/raising shall be the stainless steel lowering cable. All other cables must remain stable and secure during lowering/raising operations.

The female side of the socket contact connector shall be made of thermosetting synthetic polymer. Each set shall contain 10 socket contacts permanently molded into the polymer body. There shall be 20 high conductivity brass socket contacts with permanently attached wire leads. The male side of the socket contact block connector shall contain high conductivity brass pin contacts with permanently attached wire leads molded into a polymer body. Each disconnect unit shall have two sets of contacts with ten contacts per set (20 contacts total). The pin and socket halves of the connector shall have current carrying and signal wires in groups of 5. All wire shall be 18 AWG stranded. Pin contact half of connector shall be made of thermosetting synthetic polymer. All pins and wires shall be molded in place. A complete disconnect unit shall have two identical sets of 10 contacts each (20 contacts total). Male Pin contact halves shall be mounted to lower portion of disconnect unit.

The portable lowering device and pulleys for the lowering device shall have sealed, self lubricated bearings, oil tight bronze bearings, or sintered bronze bushings. The lowering cable shall be a minimum 1/8 inch diameter stainless steel aircraft cable with a minimum breaking strength of 1740 pounds and shall be 19 x 7 or 7 x 19.

All electrical and video connections between the fixed and moveable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts. The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits, one volt peak-to-peak video signals, and power requirements for operation of dome environmental controls. A direct coax connection is acceptable but not required.

The interface and locking components shall be made of stainless steel or aluminum. All external components of the lowering device shall be made of corrosion resistant materials, powder-coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment.

POLE MATERIALS

All materials and products shall be manufactured in the United States of America, and comply with ASTM or AASHTO specifications. Mill certifications shall be supplied as proof of compliance with the specifications.

POLE DESIGN

Pole design shall be in accordance with loading and allowable stress requirements of 2001 AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals" Fourth Edition. Loading shall be based on:

- basic wind speed of 90 mph
- 30 percent gust factor using
- 1.65 safety factor
- design life/recurrence interval of 50 years
- fatigue category I.
- galloping
- truck induced gust

The lowering device manufacturer shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum EPA, an EPA equal to or greater than that of the camera system to be attached. All drawings and calculations shall be submitted in detail demonstrating compliance with the AASHTO Specification.

To avoid vortex shedding, the steel pole members shall have a taper of 0.14 in/ft. All structures shall be designed to natural wind gust conditions. The yearly mean wind speed for natural wind gusts will be assumed to be 11.2 per hour. Design for galloping and truck-induced gust fatigue is not required for this structure.

The pole top deflection shall not exceed one inch in a 30-mph (non-gust) wind. The calculations shall include a pole, base plate, and anchor bolt analysis. The pole calculations shall be analyzed at the pole base, at 5-ft. pole intervals/segments and at any other critical pole section. Design shall be based on wind loading from a CCTV assembly dome enclosure.

Poles up to 50' in length shall be one-piece construction and shall conform to ASTM A595 Grade A with a minimum yield strength of 55 ksi or ASTM A572 with a minimum yield strength of 65 ksi. Poles greater than 50' in length shall be of two-piece construction. The shaft shall be round or 16 sided with a four inch corner radius and contain only one longitudinal seam weld. Circumferential welded tube butt splices and laminated tubes are not permitted. Longitudinal seam welds within 6 inches of complete penetration pole to base plate welds shall be complete penetration welds. The shaft shall be hot dip galvanized per the requirements of the contract documents.

POLE HAND HOLES

The pole hand hole opening shall be reinforced with a minimum 2-inch wide hot rolled steel rim. The nominal outside dimensions shall be 6 inches x 27 inches. The handhole shall have a tapped hole for mounting the portable winch as shown on the drawings.

POLE TOP TENON

A tenon shall be welded to the pole top with mounting holes and slot as required for the mounting of the lowering system. The tenon shall be of dimensions required to facilitate camera lowering device component installation. Each slot shall be parallel to the pole centerline for mounting the lowering device.

POLE CABLE SUPPORTS

Electrical Cable Guides and Parking Stand (Eyebolts): Top and bottom electrical cable guides shall be located within the pole and aligned with each other as referenced in the drawings. One cable guide shall be positioned 2 inches below the handhole and the other shall be positioned 1 inch directly below the top of the tenon. A parking stand shall be positioned 2.75 inches below the top of the handhole.

BASE PLATE

Base plates shall conform to ASTM A36 or A572 Grade 42. Plates shall be integrally welded to the tubes with a telescopic welded joint or a full penetration butt weld with backup bar. Plates shall be hot dip galvanized per the requirements of the contract documents.

POLE ANCHOR BOLTS

Anchor bolts shall conform to the requirements of ASTM F1554 Grade 55. The upper 12 inches of the bolts shall be hot dip galvanized per ASTM A153. Each anchor bolt shall be supplied with two hex nuts and two flat washers. The strength of the nuts shall equal or exceed the proof load of the bolts.

POLE WELDING

All welding shall be in accordance with Sections 1 through 8 of the AWS D1.1 Structural Welding Code. Tackers and welders shall be qualified in accordance with the code. Tube longitudinal seam welds shall be free of cracks and excessive undercut, performed with automatic processes, and shall be visually inspected. Longitudinal welds suspected to contain defects shall be magnetic-particle inspected by the manufacturer. All circumferential butt-welded pole and arm splices shall be ultrasonically or radiographically inspected by the manufacturer.

This item includes all assembly, mounting hardware, wiring, grounding, and mechanical and electrical adjustments. Due to the electrical connections involved, the CCTV Assembly must be installed to properly test the lowering device. The contractor shall demonstrate to the Engineer the proper and repeated operation of the lowering device. Proper camera operation and electrical connections shall be verified after each lowering/raising cycle.

INSTALLATION

POLE

Pole shall be installed in the correct orientation and plumb. Pole shall be grounded in accordance with the plans and specifications. Damaged galvanizing shall be repaired with a paint approved by the Engineer.

CAMERA BALANCING

The Camera shall be weighted and balanced to assure that the alignment of pins and connectors are proper for the camera support to be raised into position without binding. The lowering unit shall have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

CAMERA CONNECTIONS

The Contractor shall be responsible for meeting the ethernet(CAT6 Cable) and power requirements for wireless antennas (if required), and camera (120 volt, 18 AWG minimum).

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Pole with Lowering Device will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

RETROFIT HIGH MAST LOWERING DEVICE

DESCRIPTION

Retrofit High Mast Lowering Device shall include all work necessary to install Web Camera assembly on existing high mast lighting pole. This item includes all work required to replace existing high mast power cable with combined power, data, and video cable. This item includes furnishing and installing high mast power cable connectors. This item includes modifying the high mast ring to attach Web Camera assembly. This item includes installing splice enclosure on ring. This item includes repositioning existing luminaries to accommodate new equipment. This item includes balancing equipment on ring. This item includes all connectors and rewiring necessary to connect power and data cables. This item includes all work and materials necessary to fabricate brackets for attaching equipment.

MATERIALS

Splice enclosure shall be Hoffman Type 4X JFGQRR series or approved equal. Enclosure shall have a solid cover with quick release latches. Enclosure shall be sized to the minimum dimensions necessary to accommodate splices connectors and surge protectors. Enclosure shall be sized so that the total effective projected area of the CCTV, enclosure, and luminaries shall not exceed that of a lowering device with 12

luminaires. All external fasteners and brackets shall be galvanized, stainless steel or primed/painted as approved by the Engineer. Holophane, or approved equal mounting hardware shall be used whenever possible. Balancing weights shall be Holophane or approved equal. High mast cable connectors shall provide a sealed weatherproof connection for power and data circuits.

INSTALLATION

The Contractor shall follow the manufacturer's recommended procedures for retrofitting cable. Any additional work including removing and resetting the high mast pole shall be incidental to this bid item. The lowering device ring must be balanced for correct operation of the latching mechanism. The Contractor shall demonstrate to the Engineer, 10 flawless cycles of the latching process to verify correct balance. The Contractor shall obtain technical support from Holophane if the Contractor is not experienced in installing Holophane high mast equipment. Any cabinets that are attached to the highmast pole shall have a separate grounding system installed.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Retrofit High Mast Lowering Device will be measured for payment per unit each, complete and in place. Proper operation of the luminaries, Web Camera system and lowering device shall be demonstrated before payment is approved for this item.

INSTALL HIGH MAST CONTROL CABLE

DESCRIPTION

Install High Mast Control Cable in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Provided by the Division of Traffic Operations. The Contractor shall be responsible for picking up install items from the Frankfort pole yard and delivering these items to the site. The Contractor shall contact Frankfort pole yard personnel (502-564-3820) and arrange to pick up install items a minimum of two (2) working days prior to arrival. Failure to provide pole yard personnel this advance notice could result in long delays or refusal to distribute equipment upon arrival.

INSTALLATION

Connectors shall be installed as necessary and shall match the connector interface requirements for the equipment being connected. Adapters are not acceptable. At the completion of the project, all extra cable shall be returned to KYTC.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

High Mast Control Cable will be measured for payment per linear feet. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

PORTABLE WINCH LOWERING TOOL

DESCRIPTION

Furnish Portable Winch Lowering Tool in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Portable winch lowering tool shall be made of durable and corrosion resistant materials, powder coated, galvanized, or otherwise protected from the environment by industry-accepted coatings to withstand exposure to a corrosive environment. The tool shall consist of a lightweight metal frame and winch assembly with cable as described herein, a quick release cable connector, an adjustable safety clutch and a variable-speed, industrial-duty, battery powered drill motor. The tool shall be compatible with the winch accessible through the hand hole of the pole. When attached to the winch, the tool shall support itself and the load assuring raising/lowering operations and provide a means to prevent freewheeling when loaded. The tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise/lower a capacity load. The tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism. The tool shall be equipped with a positive locking mechanism to secure the cable reel during raising/lowering operations.

INSTALLATION

No installation is required. Portable winch lowering tools shall be delivered to a location determined by the Engineer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Portable Winch Lowering Tool will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

WEB CAMERA ASSEMBLY

DESCRIPTION

Furnish and install Web Camera Assembly in accordance with the plans, specifications and Standard Drawings.

MATERIALS

The Web Camera Assembly shall be an Axis Network Dome Model 232D+ or approved equivalent. This item shall include the color camera, zoom lenses, environmental enclosure, pan/tilt unit, housing, dome, parapet mount, and all mounting hardware, power cable, connections, and incidentals necessary to complete the work.

Proposed alternates shall be commercially available. The Contractor shall identify an installed site where the proposed alternate Web Camera Assembly has been operating for a period of at least one year in a similar climate region.

The Web Camera Assembly shall include the following:

Outdoor pendant dome:

- UV protected, distortion free, polycarbonate lower dome
- IP66 Rated
- Operating temperature: -4 degrees F to 122 degrees F
- Fan-assisted Heater: 40 degrees F turn on; 60 degrees F turn off
- Input current Max. 0.4 A
- Max Output Power 40 W
- Unit weight: 11 lbs
- Clear lower bubble
- 24 VAC outdoor power supply

Mounting Hardware:

- Pole mount adapter with banding straps and clips
- Parapet Mount

Web camera

- Image Sensor: 1/4" Sony EXview HAD CCD
- Lens: F1.4-3.0, f=4.1 mm wide to 73.8 mm tele, autofocus with 18x optical zoom
- Lens horizontal viewing angle: 48 degrees (wide end) to 2.8 degrees (tele end)
- Lens focus range: 35 mm (wide) or 800 mm (tele) to infinity
- Minimum illumination: Color:0.3 lux at 301RE, B/W: 0.005 lux at 301RE
- Video compression: Motion JPEG, MPEG-4 Part 2 (ISO/IEC 14496-2)
- Resolution: 4CIF, 2CIFExp, 2CIF, CIF, QCIF
- Resolution Max. 704x480; Min. 160x120
- Frame rate: MPEG-4 up to 21/17 fps at 4CIF/2CIFExp; up to 30/25 fps at 2CIF/CIF/QCIF

- Image settings compression levels: 11 (motion JPEG)/ 23 MPEG-4
- Pan: 360 degrees endless, max speed 360 degrees/s
- Tilt: 0 degrees to 90 degrees, max speed 360 degrees/s
- Zoom: 18x optical, 12x digital
- 20 preset
- Guard tour
- Control
- Shutter speed: 1 sec to 1/10 sec
- IR illumination
- Security: Multiple user access levels with password protection IP address filtering, HTTPS encryption
- Event management: Events triggered by built-in motion detection, external inputs or according to a schedule; Image upload over FTP, email and HTTP; Notification over TCP, email, HTTP and external outputs
- Ethernet 10BaseT/100BaseTX, RJ-45
- Video processing and compression: ARTPEC-2
- 24 VAC Power requirements
- Operating temperature: 41 degrees F to 122 degrees F
- Video access from Web browser: Camera live view. Sequence tour capability for up to 200 Axis cameras, customizable HTML pages, complete remote control pan, tilt, and zoom
- Supported protocols: HTTP, HTTPS, SSL/TLS, TCP, SNMPv1/v2cv/v3 (MIB-II), RTSP, RTP, UDP, IGMP, RTCP, SMTP, FTP, DHCP, UPnP, ARP, DNS, DynDNS, SOCKS
- EN 55022 Class A, EN 61000-3-2, EN 61000-3-3, EN 55024 approvals
- FCC Part 15 Subpart B Class A, VCCI Class A, C-tick AS/NZS CISPR 22 Class A, ICES-003 Approvals

INSTALLATION

Web Camera Assembly shall be installed on a wood pole or steel strain pole as specified in the plans and in accordance with the manufacturer's instructions. Installation shall comply with all warranty provisions and warranty contract maintenance services. Installation shall comply with all local, state, and federal building, electrical and construction codes, and Motorola R-56 requirements. All wiring access to the Web Camera Assembly shall be through watertight fittings. Wiring access points shall be on the side or underneath components; no exposed top access is permitted. The Web Camera Assembly shall be installed so that the assembly is located on the side of the pole closest to the roadway when the camera is in its fixed position at the top of the pole. The contractor is responsible to verified all functions of the web camera through a laptop interface.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Web Camera Assembly will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

COMMUNICATIONS CABLE

DESCRIPTION

Furnish and install Communications Cable in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Communications cable shall be CAT 6 SYSTIMAX 71e Series GigaSPEED XL Cable 2071 004E or approved equal. The cable shall meet or exceed the following specifications:

Performance:

- TIA/EIA 568-B.2-1 Category 6 and ISO/IEC Category 6/Class E
- Insertion Loss: 3.0%
- NEXT: 6.0 dB
- PSNEXT: 6.0 dB
- ELFEXT: 5.0 dB
- PSELFEXT: 5.0 dB
- Return Loss: 4.0 dB
- Frequency Range: 1-550 MHz

Physical characteristics:

- Nominal Jacket Thickness: 0.020 in
- Nominal Outside Diameter: 0.220 in
- Nominal Conductor Diameter: 0.022 in
- Insulation Type: Fluorinated-Ethylene-Propylene
- Jacket Material: Low Smoke PVC
- Maximum Pulling Tension: 25 lbs
- Nominal Velocity of Propagation: 0.72
- Maximum DC Resistance: 9.83 Ohms/100m
- Mutual Capacitance @ 1kHz: 4.78 nF/100m
- Operating Temperature: -20° C to 60° C
- UL Type: CMP

All connectors, terminators, fittings, etc. shall be incidental to the cost of installing the Communications Cable and no separate payment will be made.

INSTALLATION

Communications Cable shall be of suitable length to allow installation between equipment. The Contractor shall install all cable and wire splice-free from the controller/service location to each cabinet, VMS sign, or CCTV camera the cable or wire is feeding. The Contractor shall not use excessive force when pulling wire through duct. The Contractor shall replace all wire damaged during installation. The Contractor shall submit to material testing at the discretion of the Engineer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Communications Cable will be measured for payment per unit linear foot. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

CONDUIT

DESCRIPTION

Furnish and install Conduit in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Conduit shall be rigid steel, schedule 40 PVC, or flexible, non-metallic conduit as specified. This item includes fittings, connectors, clamps, caps and other materials necessary for proper installation. The Contractor shall submit to material testing at the discretion of the Engineer.

INSTALLATION

All conduit installed above ground or below ground under pavement shall be rigid steel. All conduit installed below ground, not under pavement shall be PVC. Flexible, non-metallic conduit shall be used as required and shall be incidental to the project. Unused conduits shall be capped on both ends. Conduit containing wire or cable shall be sealed with duct seal putty. All conduits shall be accessible inside junction boxes.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Rigid Steel and PVC Conduit will be measured for payment per unit linear foot. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section. A direct measurement will not be made for flexible, non-metallic conduit. All flexible, non-metallic conduit shall be incidental to the project.

ELECTRICAL SERVICE

DESCRIPTION

Furnish and install Electrical Service in accordance with the plans, specifications and Standard Drawings.

MATERIALS

The Contractor shall coordinate with the local power company to determine the exact materials for the service. This includes but is not limited to conduit, meter base, fused cutout, ground rod, wire, 35 foot wood pole, 2 anchors, connectors, fittings and all associated hardware required to construct the service.

INSTALLATION

The Contractor shall coordinate with the local power company for the exact location of the service. This item also includes all electrical inspection and other fees required to provide electrical service.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Electrical Service will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

MODEL 334 AND 336 ENCLOSURES

DESCRIPTION

Furnish and install Enclosure in accordance with the plans, specifications and Standard Drawings.

MATERIALS

The two types of enclosures are Model 336 (36" H x 24" W x 22" D) and Model 334 (66" H x 24" W x 30" D). All enclosures shall be NEMA 3R rated. The enclosures shall include: all mounting accessories, access doors, ventilation, locking system, handles, door stops, rack assembly, light(s), shelves, drawer, and all required peripherals per the requirements of the contract documents and per the equipment submitted by the Contractor. **The contractor shall provide a cabinet, wiring, and all components that are approved as an assembly. This approved assembly shall be incidental to this item. Verification that the cabinet, wiring, and all components are an approved assembly shall be submitted to Central Office Traffic Operations.**

This item includes all excavation and any special equipment required to install the enclosure on a pole for a Model 336 enclosure or construct the concrete base for a Model 334 enclosure.

The Contractor shall provide a terminal facility harness by means of mating "MS" type connectors for interconnections of the field equipment specified. All cabinets of the same type shall be identical in size, shape and quality. In addition, the cabinets shall be equipped internally as specified herein and as required to suit the specific equipment specified on the plans.

Cabinets shall be of welded construction, using 0.125" minimum thickness 5052H32 or equivalent sheet aluminum. The equipment design shall utilize the latest available techniques, minimum number of different parts, subassemblies, circuits, cards and/or modules to maximize standardization and commonality.

Cabinets shall be provided with fully wired back and side panels with all necessary terminal boards, wiring harnesses, connectors and attachment hardware. All equipment shall be shelf or 19" rack mounted. Terminals and panel facilities shall be installed on the lower portion of the cabinet walls below all shelves.

Each field cabinet shall, at a minimum, be supplied with the following:

- Fan and Thermostat
- Left Side Power Distribution Panel
- Air Filter
- Adjustable Shelves (1-4 as needed for equipment submitted by the Contractor)
- Back Panel
- Right Side Panel
- Locking System
- Ground Bus (2)
- Terminal Blocks
- Duplex power outlet
- Drawer that slides out for supporting a laptop computer
- All necessary installation and mounting hardware

All external screws, nuts and locking washers shall be stainless steel; no self-tapping screws are permitted unless specifically approved by the Engineer. All screws, nuts and locking washers used internally shall be manufactured from corrosion resistant materials.

All parts of the cabinet shall be cleaned, smoothed and free from flaws, cracks, dents and other imperfections. The cabinet shall be rigidly constructed to provide vibration free operation of the field equipment when installed. The cabinets shall be dust and rain tight and capable of maintaining a dry internal condition when subject to rain and wind gusts.

All components shall be made of corrosion resistant materials such as plastic, stainless steel, aluminum or brass; or shall be treated with corrosion resistance such as cadmium plating or galvanizing. All materials shall be resistant to fungus growth and moisture deterioration.

Individual cabinet components shall be pre-assembled upon installation in the cabinet such that the components can be easily replaced in the field. Modules of unlike function shall be mechanically keyed to prevent insertion into the wrong socket or connector.

Panels shall be designed to mount in the cabinet on mounting studs. It shall not be necessary to remove the panel to replace any panel-mounted equipment. The panels shall be capable of supporting specified equipment mounted on the panel. A lower input termination panel shall be provided to terminate all input field wires.

Electronic components shall meet the requirements contained herein and shall, at a minimum, comply with EIA Specifications. No component shall be of such design, fabrication, nomenclature or other identification as to preclude the purchase of said component from a wholesale electronics distributor or from the component manufacturer.

Components shall be down-rated by 50 percent with regard to ambient temperature, applied voltage, and power dissipation. All circuits shall be designed for reliability and maximum performance.

The design life of all components, under continuous operating conditions in their circuit application, shall be a minimum of ten years.

Each component shall meet all of its specified performance requirements when the input power is AC, 60 Hz, single phase, 120 volts +/- 20 volts. The equipment shall be designed such that the failure of a particular piece of equipment will not cause the failure of any other.

The cabinets shall be furnished with a power distribution panel mounted on the lower left hand inside wall when facing the front of the cabinet. This panel shall include a 115 VAC, convenience, dual outlet with integral ground fault interrupt protected by a circuit breaker. The left panel shall have:

- Circuit Breaker(s)
- Radio Interference Suppressor
- Power Cable Input and Junction Terminals

Circuit breakers shall be approved and listed by UL. Each cabinet shall have, at a minimum, a circuit breaker to protect the lamp, vent fan, and dual outlet. In addition, a properly rated equipment circuit breaker(s) shall be provided for the equipment shown on the plans. At each cabinet that houses VMS control equipment, a 220 VAC circuit breaker, sized to suit the cables that provide power to the VMS pixels shall be furnished and installed. Breakers shall have a minimum interrupt capacity of 50 amperes.

Each cabinet shall be equipped with a radio interference suppressor installed at the circuit breaker. The suppressor shall provide a minimum attenuation of 50 dB over a frequency range of 200 kHz to 75 MHz. The suppressor shall be hermetically sealed in a case filled with a suitable insulation compound.

The suppressor terminals shall be nickel-plated, with brass studs of sufficient external length to provide space for connection of two appropriately sized conductors and shall be mounted such that the terminals cannot be turned in the case. The suppressors shall be designed for operation at the proper current ampere rating as determined by the Contractor per the equipment specified on the plans and shall be approved by UL and EIA.

Power distribution blocks suitable for use as a power feed and junction points shall be furnished and installed for two and three wire circuits. The line side of each circuit shall be capable of handling the specified number of and size of all wires.

Each cabinet shall include a fully wired equipment panel mounted on the lower rear inside of the wall of the cabinet. The back panel shall be utilized to distribute and properly interconnect all cabinet wiring related to the specific equipment. Each piece of equipment specified shall have its cable harness properly connected at terminal boards on the back panel. All functions available at the equipment connector shall be carried in the connector cable harness to a terminal board point on the back panel.

Wiring shall be provided for the equipment specified. All cabinet wiring, where connected to terminal strips, switches, radio interference suppressor, etc., shall be identified by the use of insulated pre-printed sleeving (wire markers) slipped over the wire before attachment of the lug or terminating the connection. The wire markers shall have a text label with sufficient detail so that a translating sheet is not required.

All wires shall be cut to the proper length before assembly. No wires shall be doubled back to take up slack. Wires shall be neatly secured with nylon lacing or cable ties. Cables shall be secured with nylon cable clamps.

The grounded side of the electric service shall be carried throughout the cabinet to the ground bus without a break.

All electrical connections in the cabinet shall have sufficient clearance between each terminal and the cabinet to prevent a leakage path or physical contact under stress. Where these distances cannot be maintained, barriers must be provided. All equipment grounds shall run directly and independently to the ground bus. The lay of the interconnect cable between the components must be such that when the door is closed, it does not press against the cables or force the cables against the various components inside the cabinet. Sufficient length of cable harnesses shall be provided to easily reach the electronic equipment placed anywhere on the shelves.

All wiring containing line voltage AC shall be routed and bundled separately and/or shielded from all low voltage (i.e. control) circuits. All conductors and live terminals or parts, which could be hazardous to maintenance personnel, shall be covered with suitable insulating materials.

All conductors used in the cabinet wiring shall be 22 AWG or larger with a minimum of 19 strands. The insulation shall have a minimum thickness of 10 MILS. All wiring containing line voltage shall be 14 AWG or larger.

The AC+, AC-, and equipment ground wiring shall be electrically isolated from the other by an insulation resistance of at least 10 Megohms when measured at 250 VAC. Return and equipment grounding wiring shall be color-coded white and green respectively.

Terminal blocks located on the panels shall be accessible such that it shall not be necessary to remove the electronic equipment from the cabinet to make a connection or perform an inspection.

Terminal blocks shall be two-position, multiple-pole, and barrier type. Shorting bars, along with integral marking strip, shall be provided. Terminal blocks shall be arranged such that they do not impede the entrance, training, or connection of incoming field conductors. All terminals shall be identified by legends permanently attached to the terminal blocks. Not more than three conductors shall be brought to any one terminal screw. No electrically live parts shall extend beyond the protection afforded by the barriers. All terminal blocks shall be located below the shelves.

AC terminal blocks shall be Underwriter's Laboratory approved for 600 volts AC minimum and shall be suitable for outdoor use. Terminals used for field connections or interwiring connections shall secure conductors by means of a nickel or cadmium plated brass binder head screw.

All connections to and from the electronic equipment shall terminate at an interwiring block. These blocks shall act as intermediate connection points for all electronic equipment inputs and outputs.

A varistor shall be installed across the thermostat used to control the fan to act as a surge and transient noise suppressor. The varistor shall be GE VI5OLAIOA, Stetron 250NRO7-1, Siemens SIOK150, or approved equal.

MOUNTING

Model 336 cabinets shall be pole mounted or mounted to an existing concrete wall as specified. Model 334 cabinets shall be mounted on a poured concrete base or on existing concrete surfaces as specified. All holes drilled into existing concrete surfaces shall penetrate the concrete no more than 4 inches unless otherwise approved by the Engineer. Bolts inserted into any concrete surface shall be properly secured and epoxied, per manufacturer's recommendations. Prefabricated fiberglass bases used in lieu of poured concrete bases must be approved by the Engineer. Cabinet installation shall conform to the details shown. All cabinets shall be furnished with stainless steel mounting plates, nuts, bolts, washers and all other necessary hardware to mount the cabinet as shown or described.

DOORS

All cabinets shall be provided with doors in the front. Back doors shall be provided for Model 334 cabinets. Doors shall have secure gaskets to prevent the entrance of dust and moisture. Doors shall be sized to encompass the full area of the cabinet opening. Doors shall be provided with two stop positions to hold the door open at 90 degrees and 135 degrees. The stops shall hold the door securely open until released manually. The front door shall be hinged on the right-hand side by means of three butt hinges with 1/4" minimum stainless steel hinge pins.

VENTILATION

Cabinets shall be furnished with louvers properly designed to provide natural ventilation to the interior. The louver area shall be of sufficient size to permit the free flow of air corresponding to the rated capacity of the associated cabinet fan. A pleated media fiber filter shall be provided and shall cover all louvers.

Cabinets shall be furnished with an electric, thermostatically-controlled ventilation fan or fans mounted in the cabinet. The fan(s) shall have a rated capacity of at least 200 cubic feet per minute. The fan and cabinet ventilation louvers shall be located with respect to each other so as to direct the bulk of the air flow throughout the entire cabinet and, in particular, over the field equipment units. The thermostat shall be adjustable to turn on between 90 degrees and 120 degrees Fahrenheit.

LOCKING SYSTEM

Each door shall be furnished with a 3-point positive locking system. The lock for the door shall be a self-locking, heavy-duty, five-pin tumbler cylinder rim type. The handles shall be made of stainless steel and shall be provided with a padlock feature. Locks shall be keyed identically to Corbin #2. Two keys shall be provided for each cabinet.

LIGHT

A fluorescent light shall be provided in front for all cabinets and also in the back for Model 334 cabinets. A panel mounted 40-Watt weatherproof incandescent lamp with an on-off switch shall be positioned to provide light to the face of the equipment installed in the cabinet.

SHELF/DRAWER/RACK

A removable 19" EIA rack shall be provided for mounting sub-assemblies in Model 334 cabinet. Adjustable shelves shall be provided to hold the equipment. Vertical shelf adjustment intervals shall be 2" maximum. The shelves shall be positioned from the top of the cabinet in accordance with the actual equipment configuration of the particular cabinet. All devices/sub-assemblies shall be mounted on the rack if possible. Otherwise, they shall be placed on the shelves.

A sliding drawer shall be provided in each cabinet. The drawer shall be installed below the shelves in a suitable position for placement of a laptop computer. The drawer shall have a nominal depth of 1" and a hinged lid.

LABELING

The letters "KYTC ITS" shall be permanently displayed along the top of each door on the outside of each cabinet. The letters shall be a minimum of 1" tall. The letters shall be die-cut or engraved into the metal before galvanizing and shall be readable after galvanizing. All excess galvanizing shall be brushed off. The location and description of the label must be shown on the shop plan submittal for the cabinets. Stenciling with paint or other markers is not permitted. If required information is placed on a steel plate, the plate must match the surface profile of the cabinet. The plate must then be welded completely around the plate before galvanizing.

QUALITY ASSURANCE PROVISIONS

The following water spray test shall be performed on each empty cabinet: Water shall be sprayed from a point directly overhead at an angle of 60° from the vertical axis of the cabinet. This procedure shall be repeated for each of eight equally spaced positions around the cabinet for a period of not less than five minutes in each position. The water shall be sprayed using a domestic type-sprinkling nozzle at a rate of not less than one gallon per minute per square foot of the cabinet's surface area. The cabinet shall then be inspected for leakage. Evidence of water leakage shall be cause for rejection.

A manufacturer's certification of successful completion of the water spray test and that the cabinet conforms to these specifications shall be the basis of acceptance of the cabinet. Separate submission of test cabinets shall not be required.

MAINTENANCE

All components and assemblies shall be clearly identified with name, model number, serial number and any other pertinent information required to facilitate equipment maintenance.

All equipment shall be designed for ease of installation and maintenance. Location, accessibility, serviceability and features that will lead to simplified maintenance shall be a prime consideration. All component parts shall be readily accessible for inspection and maintenance. The only tools and test instruments required by maintenance personnel shall be simple hand tools and basic meters.

After the wiring is complete, all conduit penetrations into the cabinets shall be sealed in such a manner as to prevent rodents and insects from entering the cabinet. The conduit sealants and insect traps used shall be approved by the Engineer prior to installation.

DOCUMENTATION

Each field cabinet shall be supplied with three copies of the final cabinet wiring diagram. One copy shall be placed in a clear plastic envelope and left in the cabinet drawer. Two sets of Mylar plans shall be delivered to the Engineer.

INSTALLATION

Model 334/336 enclosure shall be installed in accordance with the plans and specifications. The Contractor shall stake all proposed enclosure locations and shall obtain approval of staked locations before excavation. A representative from the KYTC Division of Traffic Operations, Design Services Branch or the Traffic Engineer, District 2 will approve locations for all field devices. The Contractor shall have all utilities marked in the field prior to requesting approval. The Contractor shall allow two weeks to schedule this location approval with KYTC. KYTC approval of field device locations does not relieve the contractor from his responsibility to repair any damage incurred during construction. Enclosures located behind guardrail shall have minimum 5 foot spacing from edge of pole to face of guardrail. Otherwise, enclosures shall be located as specified on the plan sheets or a minimum of 30' from all driving lanes. All materials shall be installed in a neat and professional manner. All pole mount cabinets shall be

mounted approximately 42" from the ground. The Contractor shall grade and re-seed all disturbed areas to the satisfaction of the Engineer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Model 334/336 Enclosure will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

FIBER OPTIC CABLE AND FIBER TERMINATION RACK

DESCRIPTION

Furnish and install Fiber Optic Cable and Fiber Termination Rack in accordance with the plans, specifications and Standard Drawings.

MATERIALS

The Contractor shall install specified fiber optic cable and distribution equipment using the stated installation procedures. The fiber termination rack shall include rack enclosure (Corning Fiber CCH01 or approved equal), panel modules 12 fiber (Corning Fiber CCHCP1259 or approved equal), and single mode patch cords (Corning Fiber VDX9YY53FIS or approved equal).

This shall include furnishing and installing all materials, mounting hardware, and cabling necessary to construct a complete and functional system. This shall also include all labor, tools, equipment, and incidentals necessary to complete the work, including but not limited to integrated fiber optic termination units, connector modules, jumper cables, testing, and documentation.

Fiber optic cable shall be Optical Cable Company BX12 165AD SLX 900 OFNR or approved equal. Fiber optic cable, jumper cables, and distribution equipment shall be fabricated by a certified ISO 9001 manufacturer.

All fiber cable provided under this contract shall be from the same manufacturer utilizing identical specifications. Fiber cables shall be dielectric (constructed from non-metallic materials). Fiber cables shall contain single mode optical fibers, loose tube, filled with a water-blocking material, and shall be suitable for installation in underground conduit and field cabinets.

All optical fiber in the cable shall, at a minimum, comply with the following requirements:

- Min. Cladding diameter: 125+/- 1.0µm
- Core to cladding offset: 0.8µm maximum
- Maximum attenuation: 0.5 dB/km at 1310 nm

- 0.5 dB/km at 1550 nm
- Maximum chromatic dispersion: 3.2 ps/(nm x km) from 1285 nm to 1330nm
18 ps/(nm x km) at 1550 nm
- Fiber polarization mode dispersion: 0.5 ps/(km), 2 maximum
- Coating diameter: 245 μ m +/- 10 μ m

The change in attenuation for single-mode from 0° F to -150° F shall not exceed 0.2 dB/km at 1550 nm, with 80 percent of the measured values no greater than 0.1 dB/km at 1550 nm.

The cable design shall have a life expectancy of 20 years when installed to manufacturer's specifications.

Optical fibers shall be contained inside a loose buffer tube. Each buffer tube shall contain 12 fibers. The buffer tubes shall allow free movement of the fibers without fiber damage during installation or normal operation, including expansion and contraction of the buffer tubes. The diameter of all buffer tubes in a cable shall match.

The cable shall have a central member designed to prevent buckling of the cable.

The cable core interstices shall be filled with a non-nutritive to fungus, electrically non-conductive, water-blocking material such as water-swallowable tape that is dry to the touch. The water blocking material shall be free from dirt and foreign matter.

The cable shall contain a least one ripcord under the sheath for easy sheath removal.

The cable shall have tensile strength members that minimize cable elongation due to installation forces and temperature. The cable shall withstand a 600 lb. tensile load applied per EIA-455-33. The change in attenuation shall not exceed 0.2 dB during loading and 0.1 dB after loading. The cable shall be rated for a minimum installed tensile service load of 200 lbs.

The cable shall be dielectric (with no armoring) and be either HDPE or MDPE. Jacketing material shall be applied directly over the tensile strength members and water-blocking material.

The markings on the fiber optic cable shall include cable length markings.

The fiber optic cable shall be capable of withstanding the following conditions without damage or decrease in function:

- Cable freezing per EIA/TIA-455-98
- Total immersion in water with natural mineral and salt contents
- Salt spray or salt water immersion for extended periods
- Wasp and hornet spray

Cable shall be furnished in one continuous length per reel and shall be free from optical splices. A minimum length of six feet on each end of the cable shall be accessible for testing.

Information either stenciled or lettered on the reel or provided on a weatherproof tag firmly attached to the reel shall include the following:

- Factory order number
- Job number
- Ship date
- Manufacturer's cable code
- Type of cable (single mode, outdoor, indoor)
- Beginning and ending length markings
- Measured length and attenuation

FIBER OPTIC DISTRIBUTION EQUIPMENT:

SC type Connectors shall used. The measured attenuation of the connector (inclusive of coupler and mated test connector) shall not exceed an average of 0.3 dB for all connectors provided. Any connector found in excess of 0.5 dB will be rejected. Reflectance shall be less than -40 dB, from 14° F to +140° F. The manufacturer shall have a program that periodically tests connectors to ensure that, after 1000 re-matings, the attenuation shall not change more than 0.2 dB.

The connector shall be able to withstand an axial pull of 25 lbs. with no physical damage to the connector and no permanent optical degradation more than 0.3 dB. Connectors shall be pre-wired by the manufacturer.

Fiber optic jumper cables shall, at a minimum, comply with the following requirements:

- Have less than 0.2 dB loss when subjected to EIA/TIA-455-1A, 300 cycles, 0.5 kg
- Have an Aramid yarn strength member
- Have a rugged PVC sheathing
- Have a minimum bend radius of 12.5 inches following installation, 25 inches during installation
- Have a minimum tensile strength of 100 lbs
- Have connectors with strain relief pre-wired by the manufacturer
- Comply with NEC requirements for indoor fiber optic cable

Jumper cables shall be either single or duplex. Duplex jumper cables shall have permanent markings to distinguish between the fibers or connectors.

Connector modules shall consist of a connector panel, couplers, and a protective housing. The measured attenuation of the connector module (inclusive of coupler, fiber, and mated ST test connector) shall not exceed an average of 0.3 dB for all connector modules provided. Any connector module found in excess of 0.5 dB will be rejected. Connector modules shall, at a minimum, comply with the following:

- Have 6 couplers for ST applications
- Have 12 couplers for SC applications
- Have a durable housing that provides physical protection and strain relief for the termination of multi-fiber cable to couplers
- Be easily installed and removed from the termination housing
- Be furnished with protective covers for couplers on the jumper cable side
- Comply with NEC requirements for indoor fiber optic cable

There shall be a fixed correlation between each buffered fiber color and coupler position for all connector modules. Fiber color shall meet the requirements for outdoor fiber optic cable.

Fiber optic termination units shall be properly sized for the required number of terminations subject to the minimum requirements stated for each configuration. The fiber optic termination units shall, at a minimum, comply with the following requirements:

- Be rack mounted
- Have front and rear doors or removable panels
- Have a top, bottom, and 4 sides that fully enclose the interior and protect its contents from physical damage
- Be manufactured using 16 gauge aluminum or equivalent and corrosion resistant
- Have provisions for neatly routing cables, buffer tubes and fan-out tubing
- Have cable management brackets or rings integral to the unit to secure and route cables from the connector modules to the vertical rack members while maintaining a minimum 1.5 inch cable radius

INSTALLATION

Fiber optic cable shall be installed in conduit and cabinets. Fiber optic cable shall be installed in accordance with the manufacturer's installation techniques and procedures. The Contractor shall furnish and install all jumper cables and termination equipment necessary to connect fiber optic cable to the equipment.

The Contractor shall install fiber optic cable as a continuous run, without splices, between the cable ends identified. The Contractor shall label fiber optic cables at each end of the cable run, at the points where the cable enters and exits the cabinet for mid-cable access locations, and in all junction boxes. Labels for fiber optic cable shall identify the cable number and the string numbers of the fiber contained within the cable.

Installation of fiber optic cable and jumper cables shall meet the minimum requirements of local building codes and NEC Article 770. Cable shall not be pulled along the ground, over or around obstructions, over edges or corners, or through unnecessary curves or bends. Bend radius criteria of 10 times the cable diameter no stress and twenty times cable diameter under stress shall not be exceeded. Manufacturer-approved pulling grips,

cable guides, feeders, shoes, and bushings shall be used to prevent damage to cable during installation.

When cable is removed from the reel prior to installation, it shall be placed in a “figure-eight” configuration to prevent kinking or twisting. Care shall be taken to relieve pressure on the cable by placing cardboard shims at each crossover, by creating additional “figure-eights”, or by an approved equivalent method.

Prior to the installation of any fiber optic cable in conduit, the Contractor shall provide the cable manufacturer’s recommended and maximum pulling tensions to the Engineer. Included with these pulling tensions shall be a list of the cable manufacturer’s approved pulling lubricants. Lubricants shall be used in quantities and in accordance with the procedures recommended by the lubricant manufacturer.

Prior to the installation of any fiber optic cable in conduit, all cable pulling equipment shall be approved by the Engineer. The cable pulling equipment shall include a meter to display pulling tension and a mechanism to ensure that the maximum allowable pulling tension cannot be exceeded at any time during installation.

The Contractor shall furnish attachment hardware, installation guides, and other necessary equipment, not specifically listed herein, as required to install the fiber optic cable.

Fiber optic cable in junction boxes shall be properly looped and attached to the sidewall.

Slack fiber optic cable shall be coiled, labeled, and attached to cable guides.

All fibers, including spares, shall be installed from the connector modules, terminated at the appropriate fibers, and secured neatly within the termination rack.

Fiber terminations shall be neatly and permanently labeled on the connector modules to designate transmit or receive.

Blank connector panels shall be of the same finish and manufacture as the connector modules and shall be installed for all unused connector module spaces.

Prior to the installation of jumper cables, the Contractor shall provide and maintain protective covers over the optical connectors and terminations. Protective covers on unused terminations shall remain.

Jumper cables shall be installed from connector modules to end equipment, and from end equipment to end equipment in multiple cabinet configurations. Jumper cables shall be secured to provide strain relief at both the connector module and the end equipment. Manufacturer recommended installation and minimum bend radius requirements shall be adhered to. Jumper cables shall be labeled at both ends.

Any approved splices shall be made using the fusion splice technique and shall not induce more than 0.1 dB attenuation for each splice nor 0.07 dB average for all splices. Splices that exceed 0.1 dB attenuation shall be re-spliced by the Contractor at no additional cost.

TESTING

Fiber optic cables shall be tested by the manufacturer in conformance with the procedures of TIA/EIA-526-7A. Submittal of test data shall include a summary sheet that clearly illustrates measured loss versus budgeted loss. Each test result on the summary sheet shall be identified by cable number(s) and begin and end locations. The Contractor shall identify any unacceptable losses and perform corrective work at no additional cost. The maximum permissible loss for cables other than jumpers, terminations, and connector modules is 0.05 dB. Any cable not compliant shall be replaced in its entirety and re-tested for compliance. A copy of the final, summarized, post-installation test results shall be placed in a protective sleeve approved by the Engineer and attached to the rack or door.

Bi-directional (OTDR) tests shall be conducted by the manufacturer for all string paths. The OTDR tests shall document the loss for each component (connector module, jumper cable, etc.). Short runs of fiber shall be tested using a 'lead-in' cable or an 'attenuator' to obtain proper readings from the OTDR. OTDR traces shall be submitted. Each test shall be clearly annotated with the measured loss identified on the OTDR trace. All tests over 0.05 dB shall be identified on the summary sheet.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Fiber Optic Cable will be measured for payment per unit linear foot. Termination Fiber Rack will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

SIGN POST

DESCRIPTION

Furnish and install Sign Post in accordance with the plans, specifications and Standard Drawings.

MATERIALS

The following publications are applicable to the work described herein:

- Kentucky department of highways standard specifications for road and bridge Construction (2004)
- Standard highway signs -- federal highway administration
- Manual on uniform traffic control devices (2003 edition) -- federal highway

Administration

All signs shall be positioned as shown on the positioning detail sheet. All Beams and posts shall be of sufficient lengths to extend from the top of the sign to the required base embedment.

Beams shall be A-36 steel galvanized in accordance with ASTM A-123, current edition. All beams shall be either type "A" (standard beam installation). Type "A" beams are shown on the panel sign detail sheet. The type and size of beam to be used shall be indicated for each sign post on the plan sheets. Beam lengths included in these plans are for informational purposes only. The contractor shall take field measurements at each sign location and cross sections (Roadway cross section bid item) shall be developed to verify beam lengths, with any discrepancies brought to the attention of the engineer for resolution. Bracing, if required, shall be incidental.

All concrete bases shall be of class "A" concrete for sign posts and shall be as shown elsewhere in these plans. Excavation necessary to construct bases and footings is incidental to the cost of class "A" concrete for signs.

INSTALLATION

Before beginning installation, the contractor shall furnish to the resident or project engineer for written approval drawings, descriptions, manufacturer's cuts etc. covering all materials to be used. Mill test reports for beams used must be submitted to the Division of Construction and approved prior to erection.

All signs are to be located at the approximate stations listed and the exact location for each sign shall be determined by the contractor and approved by the engineer; however, if an sign is relocated more than twenty-five feet (25') from the station listed, the new location must be approved by the Division of Highway Design at (502) 564-3280.

Clearing and grubbing, and tree trimming, when required for construction of the sign posts, will be incidental to the contract and no direct payment will be allowed.

Right is reserved to inspect fabrication and erection work, an inspection (day and night) will be made after completion of installation to determine if the intent of the specifications is satisfied.

If a manufacturer's warranty is furnished to the contractor on any materials covered under these specifications, the same warranty shall be furnished to the state by the contractor.

All hardware for the attachment of the side mount VMS Signs to these supports shall be as recommended by the sign manufacturer. This hardware shall be supplied by the sign manufacturer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Sign Post will be measured for payment per unit Lb of steel and Cu Yds of concrete. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

GUARDRAIL, GUARDRAIL END TREATMENT, AND CRASH CUSHION WITH CONCRETE MEDIAN BARRIER END

DESCRIPTION

Furnish and install Guardrail, Guardrail End Treatment and Crash Cushion with Concrete Median Barrier End in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Materials shall be in accordance with Section 814 of the Kentucky Standard Specifications for Road and Bridge Construction and the Standard Drawings.

INSTALLATION

Installation shall be in accordance with Section 719 of the Kentucky Standard Specifications for Road and Bridge Construction.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Guardrail will be measured for payment per unit linear foot. Guardrail End Treatment and Crash Cushion with Concrete Median Barrier End will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

JUNCTION BOX

DESCRIPTION

Furnish and install Junction Box in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Junction box shall meet or exceed ANSI/SCTE 77-2002, tier 15. Junction box covers shall be marked "Traffic." Covers shall be attached with a minimum of two 3/8" stainless steel hex bolts.

INSTALLATION

Where required, junction box shall be oriented such that the dimensions comply with the NEC. Junction boxes used as pull boxes along a conduit run shall be spaced at a maximum of 250'. Junction boxes shall not be placed in ditch lines or in areas where standing water may accumulate. Junction box covers shall be flush with the finished surface. The Contractor shall restore all disturbed areas to the satisfaction of the Engineer.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Junction Box will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

SURGE DEVICES

DESCRIPTION

Furnish and install video surge device, data surge device, power surge device, and RF surge device in accordance with the plans, specifications and Standard Drawings.

MATERIALS

GENERAL

Each surge device shall be compatible with the equipment it is protecting. Each surge device shall include cables, connectors, power supplies, and all incidentals required for operation.

VIDEO SIGNAL COAX CONDUCTOR SURGE DEVICE

Video Signal Coax Conductor Surge Device shall be EDCO CX12-BNC-Y or approved equal. This surge protector shall:

- Have a clamping voltage response time of less than one nanosecond
- Have a maximum clamping voltage of 12 volts when subjected to a 3 kA, 8x20 microsecond wave
- Have a peak surge current of 20kA with 8x20 microsecond wave
- Have BNC connectors
- Pass signals from DC to 80 MHz with less than 3 dB insertion losses
- Be UL 497B listed

DATA SIGNAL CONDUCTOR SURGE DEVICE

Data Signal Conductor Surge Device shall be for RS 422 and RS 485 Communication conductors shall be EDCO PC642C-015 or approved equal. This surge protector shall:

- Have a clamping voltage response time of less than one nanosecond
- Have a maximum clamping voltage of 12 volts when subjected to a 1 kA 8x20 microsecond wave
- Have a peak surge current per wire of 10 kA with 8x20 microsecond wave
- Have a maximum inline resistance of 6 ohms
- Have a maximum attenuation of -3db at 50MHz

RS 232 COMMUNICATION DATA SIGNAL CONDUCTOR SURGE DEVICE

Data Signal Conductor Surge Device for RS 232 Communication conductors shall be EDCO PC642C-015 or approved equal. This surge protector shall:

- Have a clamping voltage response time of less than one nanosecond
- Have a maximum clamping voltage of 30 volts when subjected to a 1 kA 8x20 microsecond wave
- Have a peak surge current per wire of 3kA with 8x20 microsecond wave
- Have a maximum inline resistance of 6 ohms
- Have a maximum attenuation of -3 db at 0.5 MHz

100 BASE-T AND 10 BASE-T COMMUNICATION DATA SIGNAL CONDUCTOR SURGE DEVICE

Data Signal Conductor Surge Device for 100BaseT and 10BaseT Communication conductors shall be EDCO LCDP-30 or approved equal. This surge protector shall:

- Have a clamping voltage response time of less than one nanosecond
- Have a maximum clamping voltage of 30 volts when subjected to a 0.5 kA 8x20 microsecond wave
- Have a peak surge current per wire shall be 1kA with 8x20 microsecond wave
- Have a maximum attenuation shall be -3db at 100 MHz
- Have a N.E.X.T. worst pair of better than -40 db at 100 MHz
- Have a maximum attenuation of -3db at 0.5 MHz

POWER CONDUCTOR SURGE DEVICE

Conductor Surge Device for power carrying conductors shall be EDCO SHA-1210 or approved equal. This surge protector shall meet or exceed the following specifications:

- Nominal Line Voltage 120 V
- Peak Current 20,000 Amps
- Clamp Voltage 280 volt typical @ 20kA
- Response time <5ns
- Continuous Service Current 10 Amps max. 120 VAC, 60 Hz

RF ANTENNA COAX CONDUCTOR SURGE DEVICE

RF Antenna Coax Conductor Surge Devices shall meet all manufacturer recommendations for the particular use of the radio antenna coax conductors.

INSTALLATION

The Contractor shall supply surge devices in model 334/336 enclosures, VMS signs, on poles, and on sign trusses as specified on layout sheets. Surge devices shall be located in said equipment such that they are easily accessible for maintenance activities.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Surge Device will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

TRANSCEIVERS

DESCRIPTION

Furnish single channel video over fiber transceiver and single channel data over fiber transceiver to be located in cabinets and trusses for protection of and/or communications to CCTV camera cabinets, VMS Signs, and high mast pole installations.

MATERIALS

SINGLE CHANNEL DATA OVER FIBER TRANSCEIVER

Single Channel Data over Fiber Transceiver shall be IFS, DE7200-S or approved equal.

All fiber optic transceivers shall be supplied from a single manufacturer.

Fiber optic Ethernet media converters shall be provided. The system shall provide real-time 10/100 Base-T and 100 Base-FX performance. The transceiver shall be used as an Ethernet media converter supporting one Ethernet 100 Base-T electrical port and one Ethernet 100 Base-FX optical port. The transceiver shall have auto MDI/MDI-X operation that has the capability of being forced on. The transceiver shall be fully compatible with all standard IEEE 802.3, 802.3u, and 802.3x Ethernet protocols. The transceiver shall have an enhanced mode to provide the back-off algorithm changed from IEEE standard 802.3 binary exponential to aggressive mode, enable half-duplex back-pressure, disable excessive collision drop, and enable jumbo frame for streaming media applications. The transceiver requirements shall be two single mode optical fiber. The transceiver shall have a substantially wide dynamic range so as to never require optical or electrical adjustments. Optical attenuators shall never be required. The transceiver shall provide local diagnostic indicators. The transceiver shall support a remote network management option providing full interoperability with industry standard SNMP/IP protocols. All transceivers shall be available in both card mount and surface mount versions. All transceiver shall have automatic, resettable, polymer fuses on all power rails that shall provide for automatic reset, as well as, transient suppression on all data I/O connections. All card mount transceivers shall have an internal DC power supply. A short circuit in one module shall not affect the operation of other modules powered from the common power supply. All card mount transceivers shall have the ability to be inserted into and removed from the communication management chassis without interrupting power and with no risk of damage to other modules or the communications management chassis during replacement. The system shall have an ambient operating temperature of -40°C to +74°C, an ambient storage temperature of -40°C to +85°C, a relative humidity ability of 0% to 95% (non-condensing), have an option for conformal coating, and a MTBF of > 100,000 hours. The transceiver shall meet or exceed NEMA TS-1/TS-2 and Caltrans Traffic Signal Control Equipment Specifications for operating temperature, humidity, mechanical shock, vibration, and voltage transient protection. The transceiver radiated emissions shall be compliant with FCC Part 15, Class B, and EN55022 specifications. The transceiver shall use lasers that

are compliant with FDA Performance Standard for Laser Products, Title 21, Code of Federal Regulations Subchapter J.

SPECIFICATIONS

Data: One (1) channel, bi-directional

DATA SPECIFICATIONS

- Data Protocol: Ethernet
- Operating Mode: Half or full-duplex
- Enhanced or standard IEEE 802.3
- Data Rate: 10/100 Mbps
- Ethernet Compliance: IEEE 802.3, 802.3u, 802.3x
- Ethernet Isolation: 1500 VRMS, One (1) minute

OPTICAL SPECIFICATIONS

- Fiber Type: Single mode
- Wavelength: 1300/1550nm
- Number of Fibers: Two
- Optical Emitter Type: Laser
- Transmitter Output Power: 500 μ w (-3 dBm)
- Receiver Sensitivity: 5 μ w (-23 dBm)
- Optical Power Budget: 20 dB

STATUS INDICATOR SPECIFICATIONS

- Power
- Data Rate
- Auto-Negotiate
- Operating Modes
- Optical Link Detect

SINGLE CHANNEL VIDEO OVER FIBER TRANSCEIVER

Single Channel Video over Fiber Transceiver shall be IFS VADT/VADR 14130WDM or approved equal.

All fiber optic modules shall be supplied from a single manufacturer.

Digital fiber optic video and data transmitters and receivers shall be provided as required. The transceiver shall transmit a one-way, single channel of high resolution, true broadcast quality, real-time NTSC or PAL color video. The transceiver shall employ 10-bit digital encoding for transmission of these signals. The transceiver shall meet the RS-250C short-haul standard for video transmission. The transceiver shall provide bi-directional data supporting RS-232, RS-422, or 2 or 4-wire RS-485 data interfaces. The

transceiver shall be transparent to all major data protocols (i.e., Manchester Encoding, Bi-Phase, NRZ, NRZI, etc.). The transceiver requirements shall be one single mode optical fiber. The transceiver shall have a substantially wide dynamic range so as to never require optical or electrical adjustments. Optical attenuators shall never be required. The transceiver shall provide local diagnostic indicators. The transceiver shall support a remote network management option providing full interoperability with industry standard SNMP/IP protocols. All transceivers shall be available in both card mount and surface mount versions. All transceivers shall have automatic, resettable, polymer fuses on all power rails that shall provide for automatic reset, as well as, transient suppression on all video and data I/O connections. All card mount transceivers shall have an internal DC power supply. A short circuit in one module shall not affect the operation of other modules powered from the common power supply. All card mount transceivers shall have the ability to be inserted into and removed from the communication management chassis without interrupting power and with no risk of damage to other modules or the communications management chassis during replacement. The transceiver shall have an ambient operating temperature of -40°C to +74°C, an ambient storage temperature of -40°C to +85°C, a relative humidity ability of 0% to 95% (non-condensing), have an option for conformal coating, and a MTBF of > 100,000 hours. The transceiver shall meet or exceed NEMA TS-1/TS-2 Equipment Specifications for operating temperature, humidity, mechanical shock, vibration, and voltage transient protection. The transceiver radiated emissions shall be compliant with FCC Part 15, Class B, and EN55022 specifications. The transceivers shall use lasers that are compliant with FDA Performance Standard for Laser Products, Title 21, and Code of Federal Regulations Subchapter J.

SPECIFICATIONS

Video: One (1) channel, one-way

Data: One (1) channel, bi-directional, RS-232, RS-422, or 2 or 4-wire RS-485

VIDEO SPECIFICATIONS

- I/O: 1 volt pk-pk (75 ohms)
- Bandwidth: 5Hz – 10 MHz
- Differential Gain: < 2%
- Differential Phase: < 0.7°
- Tilt: < 1%
- Signal-to-Noise Ratio (SNR): 67 dB @ maximum optical loss budget

DATA SPECIFICATIONS

- Data Interface: RS-232, RS-422, or 2 or 4-wire RS-485
- Data Format: NRZ, NRZI, Manchester, Bi-Phase
- Data Rate: DC – 230 kbps (NRZ)
- Bit Error Rate (BER): < 1 x 10⁻⁹ @ maximum optical loss budget

- Operating Mode: Simplex or full-duplex
- OPTICAL SPECIFICATIONS

- Fiber Type: Single Mode
- Wavelength: 1300/1550nm
- Number of Fibers: One
- Optical Emitter Type: Laser
- Transmitter Output Power: 600 μ w (-2 dBm)
- Receiver Sensitivity: 3 μ w (-25 dBm)
- Optical Power Budget: 23 dB

STATUS INDICATOR SPECIFICATIONS

- Power
- Video Sync
- Data Receive
- Data Transmit
- Optical Link Detect

This item includes cables, connectors, power supplies, and all incidentals required for operation.

INSTALLATION

The Contractor shall single channel data over fiber transceivers and single channel video over fiber transceivers in Model 334/336 enclosures, VMS signs, on poles, and on sign trusses as specified on layout sheets. The Contractor shall be responsible for the transceivers working properly with other equipment.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Single Channel Data over Fiber Transceiver will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

TRANSFORMERS

DESCRIPTION

Furnish and install Transformer in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Transformers at locations for only cameras and/or detectors shall be 3 KVA, dry type, 480 VAC to 120 VAC step down units. Transformers at locations for VMS or locations

for VMS and cameras shall be 7 KVA, dry type, 480 VAC to 120 VAC step down units. Transformers shall be a weatherproof design for mounting without a separate enclosure. This item includes all related wiring, connectors, conduits, fittings, hardware, special brackets and all other incidentals necessary to provide a functional unit.

INSTALLATION

Transformer shall be mounted to the side of a Model 334 enclosure or on a wood pole. The Contractor shall furnish and install cabinet reinforcement plates required when mounting to the side of a cabinet.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Transformer will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

TRENCHING AND BACKFILLING

DESCRIPTION

Trenching and Backfilling shall be performed in accordance with the plans, specifications and Standard Drawings.

MATERIALS

All trenches shall be marked with underground utility warning tape.

INSTALLATION

The Contractor shall be responsible for locating all underground utilities prior to excavation. The Contractor shall excavate the trench, place warning tape above the conduit, backfill the trench and restore all disturbed areas to the satisfaction of the Engineer. Backfill material shall be placed and compacted in lifts of 9 inches or less. Incidental to this item is any Bore and jack under existing roadway.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Trenching and Backfilling will be measured for payment per unit linear foot. The Department will make payment for complete, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

VARIABLE MESSAGE SIGN

DESCRIPTION

Furnish and install Variable Message Sign in accordance with the plans, specifications and Standard Drawings.

This Specification describes minimum specifications for the VMS required by the contract. The Contractor shall provide all materials, software, and services necessary to deploy a VMS unit that fully complies with the requirements specified herein, including incidental items required for operation that may have been inadvertently omitted.

VMS shall be 3 lines by 24 characters. VMSs shall use amber LED displays to generate 18" characters. VMS enclosures shall be a walk-in type. Enclosure size shall be sufficient for a technician to replace the LED panels, power supplies, control computer, fans, heaters, filters and all other equipment from inside the VMS.

VMSs shall communicate with the District 2 central control system using wireless router.

PRE-BUILD HARDWARE SUBMITTAL

A hardware submittal shall be provided prior to production of the equipment to verify that the design operates using the NTCIP. This test will be conducted by the KYTC ITS Integrator. The VMS manufacturer shall supply a VMS controller, power supply, three display modules, and any other equipment required for bench operation of the VMS unit. This equipment will be returned after testing is complete. The VMS manufacturer shall provide documentation and support for all NTCIP components unique to the design.

The pre-build submittal shall also include the following background information regarding the VMS manufacturer:

- Full corporate name
- Corporate address
- Contact person name, telephone number, fax number, and email address
- Names and qualifications of the primary project team members, including the following: sales person, project manager, product manager, application engineer, and manufacturing manager
- Number of years in business under the current corporate name
- Copy of the VMS manufacturer's in-house, quality management system. The in house quality management system shall be ISO 9001:2000 certified. Proof of this shall be submitted with the shop drawings
- Proof of certification of VMS manufacturer's welding procedure to ANSI/AWS D1.2/D1.2M-03 Structural Welding Code for Aluminum
- Proof of certification of all welders to ANSI/AWS D1.2/D1.2M-03 Structural Welding Code for Aluminum

- Name, phone number and address of ANSI/AWS Certified Welding Inspector
- General corporate literature
- VMS product literature

Documentation proving the VMS manufacturer complies with these specifications shall be provided with the pre-build technical submittal. This submittal shall also include references from three other states that have had NTCIP-compliant VMS from the manufacturer installed for a minimum of two years and project information for all of the manufacturer's VMS customers of the last five years, including:

- Equipment owner/operator agency name
- Contact person name, telephone number, fax number, and email address
- VMS unit name and location of operations control center (project name/number, roadway name/number, state, county, and country)
- VMS commissioning date (first date of successful on-site operation)
- VMS quantity
- VMS display pixel technology (LED, fiber optic, flip disk, etc.)
- VMS display matrix size (pixel rows by pixel columns) and type (full matrix, line matrix, or discrete character)
- VMS housing access type (walk-in, front, rear, or other specific access type)
- Communications protocol used (NTCIP or proprietary; if proprietary, provide a name or description)
- Type of communications backbone used (telephone, fiber optic, direct, etc.)
- NTCIP compliance test reports, including contact information, prepared by independent testing companies.

KYTC reserves the right to contact additional references. Any poor or unsatisfactory reference, as determined by KYTC in its sole and absolute discretion, may cause the LED VMS manufacturer to be rejected.

Experiences in the manufacture of other types of electronic sign products will not satisfy the requirements of this VMS specification. Other types may be, but are not limited to:

- Indoor signs of any size or type
- Portable or mobile signs of any size or type
- Neon signs
- Back-lit signs
- Rotating drum or plank signs
- Blank out signs
- Any type of sign that is not pixilated and cannot be programmed to display a nearly infinite quantity of messages

- VMS that have a pixel technology comprised of something other than high-intensity LEDs such as incandescent lamps, liquid crystal, fiber optic, flip disk, flip-fiber combination, and flip-LED combination
 - VMS with a display matrix smaller than three lines of fifteen characters per line and having a character height smaller than 18 inches.
 - Outdoor electronic signs that are used for purposes other than roadway/motorway traffic management
- Failure to provide complete and accurate submittal information, as specified herein, shall be cause for rejecting the VMS manufacturer.

PRE-BUILD TECHNICAL SUBMITTAL

The VMS manufacturer shall provide a complete technical submittal within 60 days of contract award and shall not proceed with VMS manufacture until the Engineer has approved the submittal.

PRE-BUILD TECHNICAL SUBMITTAL

The VMS manufacturer shall provide a complete pre-build technical submittal within 60 days of contract award and shall not proceed with VMS manufacture until the Engineer has approved the submittal. The submittal shall include:

- All VMS manufacturer qualification information, as specified herein
- VMS shop drawings, including illustrations of the recommended installation method
- VMS structural calculations and certification by a registered professional engineer
- VMS site riser diagram
- AC site power requirements, including the number of legs, current draw per leg, and maximum and typical site power consumption
- Major VMS schematics, including AC power distribution inside and outside the VMS, DC power distribution within the VMS, and control signal distribution inside and outside the VMS combine with 2nd bullet?
- Drawings of major VMS components, including LED display modules, driver boards, control/logic components, environmental control assemblies, VMS controller, control equipment cabinet assembly, and control cabinet mounting
- Catalog cut sheets for major VMS components, including front face paint material, polycarbonate face material, LEDs, regulated DC power supplies, circuit board conformal coating material, hookup wire, signal cable, surge suppression devices, load center, circuit breakers, utility outlets, VMS controller, ventilation/cooling fans, heaters, ventilation filter, thermostats, and any other major system components combine with 2nd bullet?
- Test reports and certification for all items identified in the “Product Testing” where? specifications herein
- VMS control software operator’s manual
- Certificate of NTCIP compliance

VMS MANUFACTURER QUALIFICATIONS

This section describes the minimum qualifications required for a VMS manufacturer. A VMS manufacturer must meet these minimum qualifications prior to bidding. This section also details the product documentation that must be provided by the Contractor.

The VMS manufacturer for this contract shall:

- Have been in the business, under the same corporate name, of manufacturing large, outdoor, permanently mounted, LED VMS that are used to manage vehicular roadway traffic, for a minimum of ten years prior to the contract bid date. An LED VMS is defined as containing display pixels constructed solely of high-intensity, discrete LEDs.
- Have in operation a minimum of one hundred large, outdoor, permanently-mounted, LED VMS as defined above. Each of these VMS shall have been successfully operated for a minimum period of one year prior to the contract bid date.
- Have in operation, as of the contract bid date, a minimum of ten independently owned and operated VMS systems. Each of these systems shall contain a minimum of ten permanently mounted VMS that use the NTCIP as their primary communications protocol. Each of the VMSs shall be communicating over dial-up telephone, cellular telephone, spread spectrum radio, or fiber optic networks.
- Have previously demonstrated that their VMS controller is NTCIP compliant via compliance testing performed by an independent, third-party testing organization. The testing shall have been completed using industry accepted test tools such as the NTCIP Exerciser, Trevilon's NTester, Intelligent Devices' Device Tester, and/or Frontline's FTS for NTCIP.
- Utilize a documented, in-house, quality management system that has been in place for no less than two years prior to the contract bid date.
- Utilize a documented, certified, welding procedure. All welding shall be by an inert gas process in accordance with the AWS Standards, 2003 ANSI/AWS D1.2/D1.2M Structural Welding Code for Aluminum. The welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the above code. Proof of certification of all welders and applicable welding procedures shall be supplied with the submittals. The name, phone number and address of the ANSI/AWS Certified Welding Inspector who certified the welders and procedures shall also be provided with the submittals.

MATERIALS

This section describes the specifications for a full matrix, amber, aluminum, walk-in access, VMS capable of displaying multiple lines of text with multiple characters per line.

The VMS shall be Daktronics VF-2000-27x125-18-A, Skyline VMSLED-W3-18F-27x125I or approved equal.

The following specifications describe major VMS system components required, including:

- Full Matrix, Walk-In access VMS

- VMS controller
- VMS controller enclosure
- VMS control software
- NTCIP communications protocol
- VMS manufacturer qualifications
- Product testing
- Product documentation

The VMS specification describes attributes common to all sizes of 18-inch, full matrix, walk-in access VMS. For features and data that are unique to different VMS sizes, please refer to Table 1. This information can be inserted into the specification using the reference letters provided (A, B, C, etc.):

Table 1: VMS Dimensions

Pixel Rows {A}	Pixel Columns {B}	Cabinet Height {C}	Cabinet Width {D}	Cabinet Depth {E}	Weight Range (lbs) {F}
27	125	7'10" to 8'6"	29'3" to 30'8"	45 1/4" to 47"	3950 to 4080

MATERIAL, MANUFACTURING, AND DESIGN STANDARDS

VMS provided for this contract shall comply with the following standards. If no revision date is specified, the most recent revision of the standard applies:

- General VMS Requirements – The VMS shall be designed in accordance with *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (VMS), with NTCIP Requirements.*
- Aluminum Welding – The VMS housing shall be designed, fabricated, welded, and inspected in accordance with *ANSI/AWS D1.2-97 Structural Welding Code-Aluminum (1997).*
- Electrical Components – High-voltage components and circuits (120 VAC and greater) shall be designed, wired, and color-coded per the NEC.
- Protection from Environment – The VMS housing shall be designed to comply with type 3R enclosure criteria as described in *NEMA Standards Publication 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)*
- Product Electrical Safety - All VMS, associated equipment, and enclosures shall be listed by UL or an accredited third party testing organization, such as ETL Semko, and shall bear the organization’s mark. VMS shall be listed as conformant to UL 48 Standard for Electric Signs and UL 50 Enclosures for Electrical Equipment. Control equipment and enclosures shall be listed as conformant to UL 1433 Standard for Control Centers for Changing Message Type Electric Signs.
- Radio Frequency Emissions – All equipment shall be designed in accordance with Federal Communications Commission (FCC) Part 15, Subpart B as a “Class A” digital device.
- Maintenance Access and Safety – The VMS equipment provided shall be compliant with all relevant OSHA requirements.

- Structural Integrity – The VMS housing shall be designed and constructed to comply with all applicable sections of *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, Fourth Edition, 2001*, and the fatigue resistance requirements of *NCHRP Report 412, Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports*.
- Communication Protocols – The VMS controller hardware/firmware and VMS control software shall conform to the applicable NTCIP standards. Refer to the NTCIP section of this specification for detailed NTCIP requirements for this contract.

VMS CONSTRUCTION AND OPERATION

This section describes the minimum construction and operational requirements for the VMS to be supplied under this contract. The contractor shall provide all the materials, software, and services necessary to install VMS and associated equipment that fully comply with the functional requirements specified herein, including incidental items that may have been inadvertently omitted.

GENERAL

The VMS housing shall provide walk-in service access for all LED display modules, electronics, environmental control equipment, air filters, wiring, and other internal VMS components.

The VMS shall contain a full display matrix measuring a minimum of [A] rows high by [B] pixel columns wide (see Table 1). The matrix shall display messages that are continuous, uniform, and unbroken in appearance to motorists.

Each display pixel shall be comprised of multiple monochrome amber LEDs. Other pixel technologies, such as fiber optic, flip disk, combination flip disk-fiber optic, combination flip disk-LED, liquid crystal, and incandescent lamp, will not be accepted. The centers of all adjacent pixels shall be spaced 2.6” to 2.75” apart, both vertically and horizontally.

The pixel matrix shall be capable of displaying alphanumeric character fonts measuring a minimum of 18 inches high to a maximum of the display matrix height.

The VMS shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, and graphic images across multiple frames.

Legibility

VMS messages shall, at a minimum, be legible from 150 ft to 900 ft from the VMS display face under the following conditions:

- When the VMS is mounted so its bottom side is positioned between five feet and 20 feet above a level roadway surface
- Whenever the VMS is displaying 18” high, alphanumeric text

- 24 hours per day and in most normally encountered weather conditions
- During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the VMS
- When viewed by motorists that have 20-20 vision
- A range of 3 to 12 feet above the roadway surface

Dimensions (See Table 1)

VMS housing dimensions shall not exceed [C] feet high by [D] feet wide. The front-to-back housing depth shall not exceed [E] ft at its widest point, including the rear ventilation hoods. VMS weight shall not exceed [F] pounds.

Power Requirement

VMS shall operate from one of the following power sources:

- 120 VAC, 60Hz single-phase, including neutral and earth ground
- 120/240 VAC, 60Hz single-phase, including neutral and earth ground
- Two legs of 120/208 VAC, 60Hz three-phase, including neutral and earth ground

VMS Construction

The VMS housing shall be constructed to have a neat, professional appearance. The housing shall protect internal components from rain, ice, dust, and corrosion in accordance with NEMA enclosure Type 3R standards, as described in *NEMA Standards Publication 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)*. The VMS housing bottom shall contain small weep holes for draining any water that may accumulate due to condensation. Weep holes and ventilation/exhaust hoods shall be screened to prevent the entrance of insects and small animals.

External VMS component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from hot dipped or mechanically galvanized steel, stainless steel, aluminum, nylon, or other durable, corrosion-resistant material suitable for roadway signage application.

VMS controller components shall operate in a nominal temperature range of -30°F to $+165^{\circ}\text{F}$ and a relative humidity range of 0 to 99%, non-condensing. VMS controller components shall not be damaged by storage at or temporary operational exposure to a temperature range of -40°F to $+185^{\circ}\text{F}$.

Except for the environmental control fans, VMS controller components shall be 100% solid-state.

Electrical components in the VMS controller shall be UL listed and meet all NEC codes applicable to VMS applications.

The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair the performance of the VMS system. The VMS system shall not radiate electromagnetic

signals that adversely affect any other electronic device, including those located in vehicles passing underneath or otherwise near the VMS and its controller.

VMS Housing

The VMS housing shall have a NEMA 3R rating as a minimum. The VMS housing structural frame shall consist of aluminum extrusions made from 6061-T6 and/or 6063-T6 aluminum alloy. All sides of the VMS housing exterior, except the front, shall be covered with 0.125-inch thick aluminum sheets made from 5052-H32 aluminum alloy. This external aluminum skin shall be attached to the structural framework using a proven method of attachment.

VMS housing right, left, and rear walls shall be vertical. The top and bottom sides shall be horizontal. The front VMS wall shall be built with a permanent forward tilt angle of 3°, so that the top of the VMS housing is deeper than its bottom. LED display modules shall be mounted parallel to the front wall, so they are tilted 3° forward toward the motorists and the legible LED viewing area is optimized.

VMS structural assembly hardware (nuts, bolts, washers, and direct tension indicators) shall be stainless steel or galvanized A325 high-strength steel and shall be appropriately sized for the application.

Welding

The aluminum skin shall be welded to the VMS cabinet frame. All exterior sheet seams shall be continuously seam welded to the VMS frame to form a single structure. Stitch welding shall be used on the interior of the cabinet to attach the aluminum skin sheets to the aluminum extrusion frame. The VMS housing shall be welded and inspected in accordance with the requirements of *ANSI/AWS D1.2-97 Structural Welding Code-Aluminum (1997)*. Compliance with this standard shall include, but shall not be limited to, the following:

- Welding shall be performed according to documented in-house welding procedures
- Personnel who perform welding on the VMS housing shall be certified to *AWS D1.2-97* for all weld types required for housing fabrication
- A CWI shall inspect VMS welding on a daily basis and shall complete written reports that document welding progress, weld integrity, and any corrective action taken. The VMS manufacturer shall archive these reports and make them available for review, upon request of the Engineer

Mounting Brackets

Multiple mounting brackets in the form of I-beam or Z-bar extrusions shall be bolted to the VMS housing exterior rear wall to facilitate attachment of the VMS to the support structure. Mounting brackets shall be:

- Extruded from aluminum alloy number 6061-T6
- Attached to the VMS using stainless steel or mechanically galvanized A325 high-strength steel bolts

- Attached to the VMS using direct tension indicators to verify that mounting hardware is tightened properly
- Attached to the VMS structural frame members, not just the exterior sheet metal
- Installed at the VMS manufacturer's factory
- Installed such that all bracket-to-VMS attachment points are sealed and water-tight
- Designed and fabricated such that the Contractor can drill into them without penetrating the VMS housing and compromising the housing's ability to shed water

The hardware used to attach the mounting brackets (nuts, bolts, washers, and direct tension indicators) to the VMS cabinet shall be stainless steel or galvanized A325 high-strength steel and shall be appropriately sized for the application. This hardware shall be supplied by the VMS manufacturer.

Lifting Hardware

For moving and installation purposes, multiple galvanized steel lifting eyebolts or lifting angles shall be attached to the top of the VMS housing. Eyebolt hardware or angles shall be installed at the VMS factory and attach directly to the VMS housing structural frame. All mounting points for eyebolts or angles shall be sealed to prevent water from entering the VMS housing. Lifting hardware, as well as the housing frame, shall be designed such that the VMS can be shipped and handled without damage or excessive stress being applied to the housing prior to or during VMS installation on its support structure. The eyebolts or angles shall be easily removable without opening or entering the display and without any risk of compromising water-tightness. Special tools shall not be required. Removal of the eyebolts or angles shall not create holes and no replacement bolts or other hardware shall be necessary to seal the cabinet.

Front Face Construction

The VMS front face shall be constructed with multiple rigid panels, each of which supports and protects a full-height section of the LED display matrix. The panels shall be fabricated using aluminum sheeting on the exterior and polycarbonate sheeting on the interior of the panel.

Front face panels shall provide a high-contrast background for the VMS display matrix. The aluminum mask of each panel shall contain an opening optimizing the contrast ratio for each LED pixel, and shall be finished with a matte-black, licensed-factory-applied, KYNAR 500 Resin, fluoropolymer-based coating system. The face shall be uniform in appearance and completely free from distortion, gouges or any other flaws or defects. A certification shall be provided by the licensed-factory KYNAR 500 coater for all aluminum face materials. Openings shall be large enough to not block any portion of the viewing cones of the LEDs.

Adjacent face panels shall be attached to with stainless steel hardware. Seams that separate adjacent panels shall be sealed. Panels shall be mounted in such a way that they are

removable from the interior of the VMS housing. Panels shall not be welded or otherwise permanently mounted to the VMS housing.

Each panel shall have a single polycarbonate sheet attached securely to the inside of the aluminum panel. The polycarbonate sheet shall cover all of the pixel openings. The polycarbonate shall be sealed to prevent water and other elements from entering the VMS. The polycarbonate shall contain UV inhibitors that protect the LED display matrix from the effects of UV light exposure and prevent premature aging of the polycarbonate. Polycarbonate sheets shall have the following characteristics:

- Tensile Strength, Ultimate: 10,000 psi
- Tensile Strength, Yield: 9,300 psi
- Tensile Strain at Break: 125%
- Minimum Tensile Modulus: 330,000 psi
- Minimum Flexural Modulus: 330,000 psi
- Minimum Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 psi at 270° F and 66 psi at 288° F
- Coefficient of Thermal Expansion: 3.9×10^{-5} in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

LED display modules shall mount to the inside of the VMS front face panels. Common hand tools shall be used for removal and replacement.

VMS front face borders (top, bottom, and sides), which surround the front face panels and LED display matrix, shall be coated with semi-gloss black KYNAR 500 resin by a licensed-factory coater to maximize display contrast and legibility.

Wind shall not cause distortion of the VMS front face in a manner that adversely affects LED message legibility.

Exterior Finish

VMS front face panels and front face border pieces shall be coated by a licensed-factory coater with semi-gloss black KYNAR 500 resin or an equivalent brand of oven-fired fluoropolymer coating, which has a minimum outdoor service life of 20 years. All other VMS housing surfaces, including the access doors and VMS mounting brackets, shall be natural mill-finish aluminum.

Service Access

The VMS housing shall provide safe and convenient access to all modular assemblies,

components, wiring, and subsystems located within the VMS housing. All internal components and front face panels shall be replaceable by a single technician from inside the VMS enclosure.

A vertically hinged door shall be located on both ends of the VMS housing. Each access door shall be mounted to an integral doorframe, which bolts to the VMS frame using stainless steel hardware. A continuous vertical stainless steel hinge shall support the door and the door shall open outward. In the closed position, the door shall latch to its frame with a three-point draw-roller mechanism. The latching mechanism shall include an internal handle and release lever. The door release lever shall be located such that a person with no key and no tools cannot become trapped inside the housing. Each access door, when open at a 90° angle from the VMS housing rear wall, shall extend a maximum of 38 inches from the housing.

The doorframe shall be double flanged on all sides to shed water. The door shall close around its flanged frame and compress against a closed-cell foam gasket, which adheres to the door. The door shall contain a stop that retains the door in a 90° open position. When open, the door and its stop shall not be damaged by a 40 mph wind. The door shall be furnished with a lock that is keyed for a Corbin #2.

The VMS shall be equipped with an OSHA compliant safety rail assembly, which prevents service personnel from falling out of the VMS. A rail assembly shall be provided for both doors in the enclosure. The safety rail shall consist of a top rail 42 inches above the interior walkway and a mid rail 21 inches above the interior walkway. The rail assembly shall require no tools to open and close.

The VMS cabinet shall be equipped with an OSHA compliant anchor point at each entrance location for the connection of a personal fall arrest system. These anchorages shall be strong enough to withstand a force of 5,000 pounds as required by OSHA. The anchorages shall be located such that they will not allow a person to free-fall for more than 6 feet when a 6 foot lifeline is used. The anchorages must be located inside each access door within easy reach from the outside.

Interior Work Area

Minimum headroom of 72 inches shall be provided inside the VMS housing. This headroom shall be maintained across the entire VMS housing, with the exception of structural frame members. Structural members shall be designed to not obstruct the free movement of maintenance personnel throughout the VMS interior.

A level walkway shall be installed in the bottom of the VMS housing. The walkway shall be a minimum of 24 inches wide and shall run the entire length of the housing. The walkway's top surface shall be non-slip and shall be free of obstructions that could trip service personnel. The walkway shall be constructed of multiple removable panels and support a minimum load of 300 pounds per linear foot.

Interior Lighting

The VMS housing shall contain a minimum of one 4 foot, 60 watt fluorescent lamp fixture

for every eight feet of VMS housing. Lamps shall be evenly spaced across the housing ceiling to provide a uniform light distribution for maintenance purposes. Wire cages shall protect lamps. Lamp ballasts shall be rated for cold weather operation of 0°F.

Alt. internal lighting

The VMS housing shall be furnished with a minimum of four fluorescent lamps. The lights shall be enclosed in heavy-duty fixtures. Each fixture shall have die-cast aluminum housing, a twist-on guard secured by a set screw, and a porcelain socket.

Utility Receptacles

The VMS housing shall contain a utility outlet circuit consisting of a minimum of three 15 A NEMA 15-R, 120 VAC duplex outlets, with ground-fault circuit interrupters. One outlet shall be located near each end of VMS housing interior, and the third outlet shall be located near the center of the housing.

LED Display Modules

The VMS shall contain LED display modules that include LED pixel array boards and mounting hardware. These modules shall be mounted adjacently in a two-dimensional array to form a continuous LED pixel matrix. Each LED display module shall be constructed as follows:

- Each LED display module shall consist of one LED pixel board and one LED driver circuit board that can be used for controlling multiple displays. The LED driver circuit board shall be mounted to the back of the LED pixel board using durable non-corrosive hardware. LED driver boards shall be electrically connected via one or more header-type connectors. The header connectors shall be keyed such that the boards cannot be connected incorrectly.
- LED display modules shall be mounted to the rear of the display's front face panels using durable non-corrosive hardware. No tools shall be required for module removal/replacement. The modules shall be mounted such that the LEDs emit light through the face panel's pixel holes and such that the face panel does not block any part of the viewing cone of any of the LEDs.
- LED display module power and signal connections shall be via a quick-disconnect, locking-type connector. Removal of a display module from the VMS, or a pixel board or driver circuit board from its display module, shall not require a soldering operation.
- Removal or failure of any LED module shall not affect the operation of any other LED module or VMS component. Removal of one or more LED modules shall not affect the structural integrity of any part of the VMS.
- LED display modules shall be designed to that it is not possible to mount an LED display module upside-down or in an otherwise incorrect position within the VMS display matrix.
- All LED display modules, LED pixel boards and driver circuit boards shall be identical and interchangeable throughout the VMS.

LED Pixel Boards

Each LED pixel board shall be composed of a printed circuit board to which LED pixels are soldered. The LED pixel boards shall conform to the following specifications:

- LED pixel boards shall be manufactured using a laminated fiberglass printed circuit board.
- Each LED pixel circuit board shall contain a minimum of 45 LED pixels configured in a two dimensional array. The pixel array shall be nine pixels high by five pixels wide.
- The distance from the center of one pixel to the center of all adjacent pixels, both horizontally and vertically, shall be 2.6-inches to 2.75 inches.
- Each pixel shall consist of a minimum of two independent strings of discrete LEDs. All pixels shall contain an equal quantity of LED strings.
- The failure of an LED string or pixel shall not cause the failure of any other LED string or pixel in the VMS.
- Pixels shall contain the quantity of discrete LEDs needed to output a minimum intensity of 40 candelas when operated within the forward current limits. This shall yield an overall minimum luminous intensity for the sign face of 9,200 Cd/m².
- Each LED pixel shall not consume more than 1.5 watts.
- All exposed metal on both sides of the LED pixel board, except connector contacts, shall be protected from water and humidity exposure by a thorough application of conformal coating. Bench level repair of individual pixels, including discrete LED replacement and conformal coating repair, shall be possible.
- All LED pixel boards shall be identical and interchangeable throughout the VMS.

Discrete LEDs

VMS pixels shall be constructed with discrete LEDs manufactured by Agilent Technologies or approved equal. Discrete LEDs shall conform to the following specifications:

- LEDs used in VMS shall be from the same manufacturer and of the same part number.
- LEDs 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 in a T1-3/4 style LED package.
- LEDs shall emit amber light that has a peak wavelength of 590 ± 5 nm. LEDs shall be obtained from no more than two consecutive color bins. The LED manufacturer shall perform color sorting of the bins.
- All pixels shall have equal color and on-axis intensity. All pixels, including spare parts, shall have equal color and on-axis intensity. The method used to provide the equal color and intensity shall be included in the submittals and approved by the Engineer.

- The various LED color and intensity bins shall be distributed evenly throughout the VMS and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- LEDs shall have a nominal viewing cone of 15° with a half-power angle of 7.5° measured from the longitudinal axis of the LED. Viewing cone tolerances shall be as specified in the LED manufacturer's specifications and shall not exceed $\pm 3^\circ$.
- The LEDs shall be driven with a nominal 20 mA current.

LED Driver Circuit Board

An electronic driver circuit board shall be provided for each LED pixel module and shall individually control all pixels on that module. The driver circuit boards shall conform to the following specifications:

- LED driver boards shall be manufactured using a laminated fiberglass printed circuit board.
- All exposed metal on both sides of the LED driver board, except connector contacts, shall be protected from water and humidity exposure by a thorough application of acrylic conformal coating or silicone resin conformal coating.
- Bench level repair of individual components, including conformal coating repair, shall be possible.
- LED driver boards shall be microprocessor-controlled and shall communicate with the VMS controller via a wire or fiber optic communication network using an addressable network protocol. The microprocessor shall process commands from the VMS controller to display data, perform diagnostic tests, and report pixel and diagnostic status.
- Constant current LED driver ICs shall be used to prevent LED forward current from exceeding the maximum discrete LED drive current when a forward voltage is applied.
- LED pixels shall be directly driven using PWM of the drive current to control the display intensity. This LED driver circuitry shall vary the current pulse width to achieve the proper display intensity levels for all ambient light conditions. The drive current pulse shall be modulated at a frequency high enough to provide flicker-free operation and a minimum of 200 brightness levels.
- LED driver boards shall be capable of receiving updated display data at a minimum rate of ten frames per second from the VMS controller.
- LED driver boards shall be capable of receiving multiple power feeds from a minimum of two independent power supplies.
- LED driver boards shall contain a microprocessor-controlled power regulation circuit that controls the voltage applied to the LED strings. The power regulation circuit shall automatically adjust the forward voltage of the LEDs to optimize power consumption efficiency as the temperature changes. Indicator LEDs shall be provided to indicate the status of each power source. The power regulation circuit shall monitor the incoming power supply feeds and automatically select one or more to power the LEDs. If any of the incoming power sources fail, the power system shall automatically switch to one or more of the remaining power

sources. The voltage of each power input shall be measured to the nearest tenth of a volt and reported to the VMS controller upon request.

- LED driver boards shall contain a temperature sensor and shall report the temperature to the VMS controller upon request.
- The LED driver circuitry shall be capable of detecting that individual LED strings or pixels are in an off state and shall report the pixel status to the VMS controller upon request.
- Each LED driver board shall contain a seven segment numeric LED display that indicates the functional status of the driver and pixel boards. At a minimum, it shall indicate error states of the LED pixels and communication network. The indicator shall be positioned such that a maintenance technician can easily view the status code for diagnostic purposes. The status codes shall also be reported to the VMS controller upon request.
- All driver circuit boards shall be identical and interchangeable throughout the VMS.
- Removal or failure of a single driver circuit board shall not affect the performance of any other LED display module in the VMS.
- Individual addressing of each driver circuit shall be configured via the communication wiring harness and connector. No on-board addressing jumpers or switches are allowed.

Regulated DC Power Supplies

Regulated DC power supplies shall be identical and interchangeable throughout the VMS and shall conform to the following specifications:

- Output variance: $\pm 10\%$
- Nominal maximum output power rating: 1000 watts
- Operating input voltage range: 90 to 260 VAC minimum
- Operating temperature range: -30°F to $+165^{\circ}\text{F}$ minimum
- Maximum output power rating shall be maintained over a minimum temperature range of -30°F to $+140^{\circ}\text{F}$
- Power supply efficiency: 75% to 80% minimum
- Power supply input circuit shall be fused
- Automatic output shut down and restart capability if the power supply overheats or one of the following output faults occurs: over-voltage, short circuit, or over-current
- Power supplies shall be UL listed
- Printed circuit boards shall be protected by an acrylic conformal coating or silicone conformal coating

The LED pixel display modules shall be powered with auto-ranging, regulated, switching, power supplies that convert the incoming AC to DC at a nominal voltage of 12 or 24 volts DC. Power supplies shall be wired in a redundant parallel configuration that uses multiple supplies for the VMS display matrix.

Power supplies within each pair shall be redundant and rated such that if one supply fails, the remaining supply shall be able to operate 100% of the pixels in that display region at 100% brightness when the internal VMS air temperature is +140°F or less.

The power supplies shall be sufficient to maintain the appropriate LED display intensity throughout the entire operating input voltage range.

The output of each power supply shall be connected to multiple circuits that provide power to the LED modules. Each output circuit shall not exceed 15 A.

Each group of power supplies shall be monitored by a microprocessor-controlled circuit. This circuit shall monitor the voltage of each power supply and the status of each output circuit's fuse. The power supply voltages and fuse states shall be reported via a CAN communication network to the VMS controller upon request.

Environmental Monitoring Systems

The VMS shall include sensors that monitor external light level, internal and external temperature, and internal humidity.

Sensors that measure the outdoor ambient light level and the outdoor ambient temperature at the VMS site shall be mounted in-line with the VMS housing walls. This ambient light and temperature measurement system shall consist of three electronic light sensors.

Two of the light sensors shall be placed such that they measure the ambient light levels striking the front and rear of the VMS. The third light sensor shall be mounted to the floor of the VMS housing and shall face the ground. The VMS controller shall continuously monitor the light sensors and adjust the LED display matrix intensity to a level that displays a legible message on the VMS face.

A minimum of one ambient temperature sensor shall be mounted to either the rear wall or bottom of the VMS housing and shall be placed such that it is never in direct contact with sunlight. The external temperature sensor reading shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

A minimum of one temperature sensor shall be mounted near the top of the VMS interior. The sensor shall measure the temperature of the air in the cabinet over a minimum range of -40°F to +176°F. The internal temperature sensor output shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

The VMS shall contain one sensor that measures the relative humidity of the air inside the VMS cabinet. The sensor shall monitor the humidity from 0 to 100%. The humidity sensor output shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

Interior VMS Environmental Control

The VMS shall contain systems for internal ventilation, face panel fog and frost prevention, and safe over-temperature shutdown.

Housing Ventilation/Exhaust System

The VMS shall contain a ventilation system designed to keep the internal VMS air temperature lower than +140°F when the outdoor ambient temperature is +115°F or less.

One filtered air intake port shall be provided for each exhaust port. Intake ports shall be located on the rear VMS wall. Each intake port shall be covered with a filter that removes airborne particles measuring 500 microns and larger in diameter. Each exhaust port shall be located near the top of the rear VMS wall.

One or more ball bearing-type fans shall be mounted at each intake port. These fans shall create positive pressure inside the VMS cabinet.

Fans and air filters shall be removable and replaceable from inside the VMS housing.

An aluminum hood shall cover each air intake and exhaust port. Openings shall be screened to prevent the entrance of insects and small animals. All intake and exhaust hoods shall be sealed to prevent water from entering the VMS.

A thermostat or multiple temperature sensors shall be used to activate the ventilation system.

A manual override timer switch shall be located inside the access door or centrally located to manually activate the ventilation system. The switch shall be adjustable from zero to four hours.

Front Face Panel Defog/Defrost System

The VMS shall contain a defog/defrost system that automatically warms the VMS front face when the internal VMS relative humidity is near condensation levels. This system shall keep the front face polycarbonate panel free of frost and condensation. The heat generated by the defog/defrost system shall not damage any part of the VMS. A thermostat or temperature sensors shall automatically activate the defog/defrost system.

Over Temperature Safety Shutdown

The VMS shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal cabinet air temperature exceeds a maximum threshold temperature. The threshold temperature shall be configurable and shall have a default factory setting of 140°F.

VMS Controller Signal Interface

For systems with controllers mounted inside the VMS cabinet, the controller to VMS interface shall use shielded Category 5 copper cable. There shall be an access panel for laptop connections mounted at the base of the truss base for remote access to the VMS controller.

Wiring and Power Distribution

Power and Signal Entrances

Two threaded conduit hubs shall be located on the rear wall of the VMS housing. One hub shall be for incoming AC power and the other shall be for incoming VMS signal cabling or a communications line.

Load Center

The VMS shall contain a power load center and circuit breakers that meet the following minimum requirements:

- Service entrance-rated
- Minimum of 20 circuit breaker mounting positions
- Short circuit rating of 22,000 amps for the main breaker
- Short circuit rating of 10,000 amps for the branch circuit breakers
- UL listed load center and circuit breakers

Internal Wiring

Wiring for the LED display module control, environmental control circuits, and other internal VMS components shall be installed in the VMS housing in a neat and professional manner. Wiring shall not impede the removal of display modules, power supplies, environmental control equipment, or other VMS components. Wires shall not make contact with or bend around sharp metal edges. All wiring shall conform to the NEC.

Earth Grounding

The VMS manufacturer shall provide one lug to be used as an earth ground that is electrically bonded to the VMS housing. The lug shall be installed near the power entrance location on the VMS housing rear wall. The Contractor shall provide the balance of materials and services needed to properly ground the VMS to earth. All earth grounding shall conform to the NEC.

Transient Protection

The VMS controller signal and power inputs shall be protected from electrical spikes and transients as follows:

- Site AC Power - The AC power feed shall be protected at the load center by a parallel-connected surge suppressor rated for a minimum surge of 10 kA.
- Control Equipment AC Power - A series-connected surge suppressor capable of passing 15 amps of current shall protect the VMS controller and other control and communication equipment. This surge suppressor shall conform to the following requirements:
 - Withstand a peak 50,000 ampere surge current for an 8x20 μ s wave form
 - Maximum continuous operating current of 15 amps at 120 VAC, 60 Hz
 - Series inductance of 200 micro henrys (nominal)
 - Temperature range of -40°F to +158°F
 - Approximate dimensions of 3" Wide x 5" Long x 2" High
 - The device shall be UL-1449 listed

- UL 1449 surge rating of 400 V or less
- Communication Signals- Transient voltage surge suppressors shall protect all communication signals connecting to the control equipment from off-site sources using other cables. Transient voltage surge suppressors shall protect all communication lines used to pass data between the VMS controller and VMS.

PRODUCT TESTING

The VMS manufacturer shall provide documentation indicating that the VMS has been tested to the standards below. It is acceptable for the testing to be performed on scale-sized versions of the actual VMS provided that the test unit is functionally and structurally equivalent to the full size VMS.

Third party test reports shall be submitted for the following:

- *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements* – Section 2, Environmental Requirements. Test report shall detail results of mechanical vibration and shock, electrical noise and immunity, temperature, and humidity.
- UL 48 Standard for Electric Signs, UL 50 Enclosures for Electrical Equipment, and UL 1433 Standard for Control Centers for Changing Message Type Electric Signs. The UL report numbers for all VMS and control equipment manufactured by the VMS manufacturer shall be listed by UL or an accredited third party testing organization, such as ETL Semko, and shall bear the organization's mark.
- NTCIP 1201:1996, NTCIP Global Object Definitions (including Amendment 1)
- NTCIP 1203:1997, Object Definitions for Dynamic Message Signs (including Amendment 1)
- NTCIP 2101:2001, Point to Multi-Point Protocol Using RS-232 Subnetwork Profile.
- NTCIP 2103 (Draft v1.13), Point-to-Point Protocol Over RS-232 Subnetwork Profile.

The test reports shall include testing of sub-network communications, objects in all mandatory conformance groups, and a subset of the remaining objects as deemed appropriate by the testing organization.

When required by the testing standards, the tests shall be performed by independent third party testing facilities. Certified test reports signed by the testing facility personnel shall be submitted for verification by the Engineer.

VMS HOUSING STRUCTURAL CERTIFICATION

A Registered Professional Engineer shall analyze the VMS structural design and shall certify that the VMS is:

- Engineered to 2001 AASHTO and NCHRP Report 411 specifications for basic wind speeds up to 140 mph and centerline sign heights up to 40 feet.
- Engineered to withstand group loading combinations as outlined in *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, Fourth Draft, 2001* including: VMS weight, repair personnel and

- equipment, snow (40 psf), ice and wind loads, and shall also meet strength requirements for truck-induced gusts as specified in *NCHRP Report 412*.
- Compliant with the fatigue resistance requirements of *NCHRP Report 412, Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports*.
 - Capable of withstanding the temporary effects of being lifted by the lifting eyebolts or lifting angles provided

The Professional Engineer shall analyze the complete VMS structural design. This includes the housing, mounting brackets, lifting eyebolts/angles, and bracket-to-housing mounting hardware (nuts, bolts, washers, direct tension indicators, etc.) provided by the VMS manufacturer. Analysis shall include, but shall not be limited to:

- The quantity and type of mounting brackets to be provided
- The quantity and type of hardware (nuts, bolts, washers) used to attach the mounting brackets to the VMS
- Verification that no problem due to the use of dissimilar metals will exist and/or affect the structural integrity of the VMS-to-bracket attachment points
- A recommendation of the number of attachment points and the attachment locations that the installing contractor should use when mounting the VMS to its support structure
- The quantity and type of lifting eyebolts or lifting angles to be provided

The VMS manufacturer shall include a sealed and signed copy of the Professional Engineer's P.E. certification and all supporting calculations with the pre-build technical submittal.

Requirements for VMS Controllers

This section describes the minimum specifications for the VMS controllers to be provided with this contract. Each VMS shall include a VMS controller and associated equipment. The contractor shall provide all the materials, software, and services necessary to install VMS controllers and associated equipment that fully comply with the functional requirements specified herein, including incidental items required for operation that may have been inadvertently omitted.

General Requirements

Each VMS shall be controlled and monitored by an individual VMS controller. One controller shall be provided for each VMS. The VMS controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VMS control software in order to perform most VMS control functions.

The VMS controller shall meet the following operational requirements:

- Communicate using the NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with LCD and keypad for direct operation and diagnostics

- Contain a minimum of three NTCIP-compliant RS232 communication ports
- Contain a minimum of one NTCIP-compliant Ethernet port with RJ45 connector
- Contain a built-in Hayes-compatible modem with standard RJ11 connector
- Contain VMS-specific control firmware (embedded software) that monitors all external and internal sensors and communication inputs and controls the display modules as directed by external control software and the front panel interface

NTCIP shall be supported in the VMS controller. External protocol converter or translator devices shall not be allowed

OR

The VMS controller shall be a multiple-sourced, non-proprietary, 19-inch rack-mountable, Type 2070 traffic controller conforming to the latest CALTRANS Specifications and shall be provided with NTCIP-compliant, resident software stored in non-volatile memory. The 2070 shall perform all communication, control and feedback functions and shall be the only VMS controller. No intermediate control device shall be used.

Controller Location

The VMS controller and associated communication equipment shall be installed inside the VMS housing.

Environmental

The VMS controller shall meet the following requirements defined in *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements*.

VMS Controller Operational Requirements

This section describes the VMS Controller Operational Requirements

Front Panel User Interface

The VMS controller's front panel shall include a keypad and LCD. These devices shall be used to perform the following functions with the VMS controller and VMS:

- Monitor the current status of the VMS controller, including the status of all sensors and a monochromatic WYSIWYG representation of the message visible on the display face
- Perform diagnostics testing of various system components, including pixels, power systems and sensors
- Activate messages stored in memory
- Configure display parameters, including display size and colors
- Configure communications port settings and NTCIP options

The front panel interface shall also include:

- Power switch to turn the controller on and off
- LED power ON indicator

- Local/Remote switch that places the controller in local mode such that it can be controlled from the front panel interface
- LED to indicate state of the Local/Remote mode switch
- Reset switch to quickly restart the controller
- LED “Active” indicator that blinks when the controller is operating correctly
- LED to indicate when any of the NTCIP communication channels are active

Memory

The VMS controller shall have non-volatile, electronically-changeable memory. This memory shall be flash or battery-backed static RAM ICs that retain the data in memory for a minimum of 30 days following a power loss. This changeable memory shall be used to store messages and schedules. The controller memory shall be capable of storing a minimum of 100 changeable messages in non-volatile RAM.

Internal Clock

The VMS controller shall contain a computer-readable clock that has a battery backup circuit. The battery shall keep the clock operating properly for at least five years without external power, and the clock shall automatically adjust for daylight savings time and leap year using hardware, software, or a combination of both. The clock shall be set electronically by the VMS controller microprocessor and shall be accurate to within one minute per month.

Communications

All remote communication ports shall be NTCIP-compatible as defined in the “Requirements for NTCIP Compatibility” section of these specifications.

Communication Modes

VMS controller shall be capable of receive instructions from and provide information to a computer containing VMS control software using the following communication modes:

- Remotely, via direct or dial-up communications, with a remote computer. The system communications backbone and all field modems and signal converters shall provide the VMS controller with an RS232 signal.
- Locally, via direct connection with a laptop computer that is connected directly to the VMS controller using an RS232 null modem connection.

Serial Communication Ports

The VMS controller shall contain a minimum of three NTCIP-compatible RS232 communication ports. These ports shall support multiple communication interfaces, including, but not limited to, direct null-modem (for local laptop control), dial-up and leased-line modems, radio systems, cellular modems, and fiber optic modems. The RS232 ports shall all have standard DB9M connectors.

The baud rate, connection type, and NTCIP communication protocol shall be configurable. Each port shall support all standard serial baud rates ranging from 1200 to 115,200 baud. Each port shall be capable of supporting either NTCIP 2101 (PMPP) or NTCIP 2103 (PPP) sub network profiles. Each port shall also be capable of supporting

either NTCIP 2201 (Null) or NTCIP 2202 (Internet) transport profiles. Only one each of the transport and sub network profiles shall be active at any time on a port.

Ethernet Port

The VMS controller shall contain a minimum of one 10/100Base-T Ethernet communication port. This port shall be available for optional use for communicating from the central control system to the VMS controller when an Ethernet network is available. The Ethernet port shall have a standard RJ45 connector.

Communications via the Ethernet port shall be NTCIP-compatible using the NTCIP 2202 Internet transport profile and the NTCIP 2104 Ethernet sub network profile. This shall permit the controller to be operated on any typical Ethernet network using TCP/IP and UDP/IP.

Dial-Up Modem Communication Port

The VMS controller shall include one dial-up modem. The modem port shall have a standard RJ11 connector.

The modem shall be capable of supporting either NTCIP 2101 (PMPP) or NTCIP 2103 (PPP) sub network profiles. The modem port shall also be capable of supporting either NTCIP 2201 (Null) or NTCIP 2202 (Internet) transport profiles. Only one each of the transport and sub network profiles shall be active at any time on the port.

The modem shall be configurable to support both incoming and outgoing calls as supported by NTCIP. The modem shall support a minimum communication speed range from 1200 baud to 28,800 baud. The modem shall support the following protocols at a minimum: AT command set, MNP5, MNP10, and V.42bis.

Controller Addressing

The VMS controller shall use whatever addressing scheme is appropriate for the NTCIP network types used for communications. The controller addressing shall be configurable through the front panel user interface.

NTCIP 2101 (PMPP) networks shall be configured with an address in the range 1 to 255 with a default address of 1. NTCIP 2104 (Ethernet) networks shall use a static IP address. Both the IP address and subnet shall be configurable. NTCIP 2103 (PPP) networks shall not require network addressing.

Transient Protection

The RS232 and Ethernet communication ports in the VMS controller shall be protected with surge protection between each signal line and ground. The telephone communication port shall be protected by a series/parallel two-stage suppression device that protects the modem from over-voltage and over-current conditions.

VMS Control Outputs

The VMS controller shall transmit and receive data packets to and from the VMS via dedicated communication cables. These cables shall be either multi-mode fiber optic cable with ST-style connectors or stranded, twisted pair, optically-coupled, 300 V, shielded cable. This network will communicate with all sensors, drivers, and other devices utilizing a CAN bus network running throughout the VMS.

Data transferred shall include pixel states, sensor values, and I/O readings from various devices, such as door sensors and power supply monitors. Pixel data shall include the information to be displayed on the VMS face as well as diagnostic data retrieved from the LED drivers.

Messaging

The VMS controller shall have the ability to display messages on the VMS display face

Message Presentation on the VMS Display Matrix

The VMS controller shall control the LED drivers such that the appropriate message is displayed on the VMS. At a minimum, the VMS controller shall support the following features

- *Display of alpha numeric characters, including letters, numbers, and punctuation*
- Selection of particular character fonts
- Horizontal alignment of text on the display, including left, center, and right justification
- Vertical alignment of text on the display, including top, middle, and bottom justification
- Adjust the spacing horizontally between characters or vertically between lines of text
- Alternate between pages of a multiple-page message
- Display graphic bitmaps of various sizes ranging from very small to the size of the entire VMS matrix

Message Effects

The VMS shall be capable of displaying messages using the following types of effects:

- **Static Message** – The selected message is displayed continuously on the VMS face until the VMS controller blanks the VMS or causes the display of another message
- **Flashing Message** – All or part of a message is displayed and blanked alternately at a rate between 0.1 seconds and 9.9 seconds. The flash rate shall be user programmable in increments of 0.1 seconds
- **Scrolling Message** – The message moves across the display face from one side to the other. The direction of travel shall be user selectable as either left-to-right or right-to-left with variable display speeds.
- **Multiple-Page Message** – A message contains up to six different pages of information, with each page filling the entire pixel matrix. Each page's display time shall be user programmable from 0.1 seconds to 25.5 seconds, and adjustable in increments of 0.1 seconds.

Message Activation

Messages shall be capable of being activated on a VMS in three ways:

- Manual – An operator using the front panel LCD/keypad interface or NTCIP-compatible control software manually instructs a particular message to be activated.
- Schedule – The internal time-based scheduler in the VMS shall be capable of being configured to activate messages at programmable times and dates. Prior to activation, these messages and their activation times and dates shall be configured using the control software.
- Events – If configured by the control software, certain events, like a power loss, may trigger the activation of pre-configured messages when they occur.

A displayed message shall remain on the VMS until one of the following occurs:

- The duration of the message expires
- The controller receives a command to change the message
- The controller receives a command to blank the VMS
- The schedule stored in the controller's memory indicates that it is time to activate a different message
- A special event, such as a loss of communication, occurs that is linked to message activation

It shall be possible to confer a "priority" status onto any message, and a command to display a priority message shall cause any non-priority message to be overridden.

Schedule Activation

The VMS controller shall support the activation of messages based on a time/date-based schedule. The format and operation of the message scheduler shall be per the NTCIP 1201 and NTCIP 1203 standards.

Display of Alphanumeric Text

The VMS controller shall support the storage and use of a minimum of 12 fonts with which messages can be formatted and displayed. Each font shall support up to 255 characters. All text font files shall, at a minimum, include the following characters:

- The letters "A" through "Z", in both upper and lower case
- Decimal digits "0" through "9"
- A blank space
- Eight directional arrows
- Punctuation marks, such as: . , ! ? - ' ' " " : ;
- Special characters, such as: # & * + / () [] < > @

The VMS manufacturer shall equip the VMS controller with the fonts in Table 2 preinstalled. The controller shall support changing or replacing these fonts from the central software using NTCIP.

Table 2: Fonts

Font Name	Character Height	Character Width (avg.)	Variable or Fixed Width	Stroke Width
7x4	7	4	Variable	Single
7x5	7	5	Fixed	Single
7x6	7	6	Variable	Double
Graphic 7	7	N/A	Variable	N/A
8x4	8	4	Variable	Single
8x6	8	6	Variable	Double
9x6	9	6	Variable	Double
11x7	11	7	Fixed	Double
14x8	14	8	Fixed	Double
14x10	14	10	Variable	Triple
16x8	16	8	Variable	Double
16x10	16	10	Variable	Triple

Display of Graphic Images

The VMS control software shall support the inclusion of graphics in messages. If the NTCIP 1203 v2 standard has not reached a “recommended” or “approved” state by the time of contract award, the manufacturer shall support graphics using manufacturer-specific objects and MULTI tags.

If a manufacturer-specific means of supporting graphics is used, the manufacturer shall commit to provide NTCIP 1203 v2 firmware updates at no cost to the cabinet. These updates shall include all current requirements of these specifications and standard graphics support. The updates shall be installed by the vendor no later than six months after the NTCIP 1203 v2 standard reaches the “approved” state.

VMS Intensity Control

The VMS controller shall provide means to change the brightness of the display matrix automatically. This automatic intensity control mode shall monitor the ambient light sensors or photo circuit of the VMS. The control shall have a minimum of 100 intensity levels, which can be communicated to the LED drivers in the VMS.

System Status Monitoring and Diagnostic Testing

The VMS controller shall be capable of monitoring the status of the VMS components and subsystems in real-time and/or manual modes, depending on the component or subsystem. The following sections detail the status and diagnostic information that shall be provided by the controller. The status and diagnostic data shall be available via the front panel LCD screen and shall be transmitted via NTCIP to control software upon request.

Message Display Status

The VMS controller shall be capable of monitoring and displaying the currently active message (if any) on the controller's front panel LCD display. This display shall be in a WYSIWYG format.

LED Pixel Testing

Upon command from either the front panel control interface or via NTCIP using remote software, the VMS controller shall direct all of the LED modules to perform diagnostic tests of all their pixels. The controller shall then collect and report the results of the pixel testing.

The VMS controller shall be capable of real-time, automatic detection of the on/off status of each of the display's pixels and reporting of such information as required. This monitoring shall take place without interfering with the display on the VMS face.

Power Supply Operation

The VMS controller shall be capable of full time monitoring and have the ability to report the voltage (to the nearest tenth of a volt) of each regulated DC power supplies located in the VMS by monitoring diagnostic outputs located on the supplies.

Door States

The VMS controller shall monitor and report the open/closed status of each of the VMS housing's doors (if equipped with door sensors). If a control equipment cabinet is present and is equipped with door sensors, the VMS controller shall also monitor the status of the control cabinet door(s).

Environmental Conditions

The VMS controller shall be capable of monitor and reporting the readings of constantly? All light, temperature, and humidity sensors installed in the VMS housing.

Error Notification

The VMS controller shall be capable of automatically informing a maintenance operator (via the local LCD panel) and a central control system (via NTCIP communication) of the occurrence of events and subsystem failures.

All component and subsystem errors shall be indicated on the controller's LCD front panel.

The VMS controller shall be capable of sending event notifications to the central control system via SNMP traps as allowed by NTCIP. When an event occurs, the VMS controller shall create a data packet for transmission to the central controller that contains details about the event. The transmission of traps shall be governed by the NTCIP standards. The controller shall be configurable to enable or disable the transmission of traps for each event or error type. This configuration shall include the automatic initiation of these traps, including establishing communications if appropriate, when the NTCIP network permits transmission initiation by the VMS controller.

Error Reporting

The following sections list errors and events that the controller shall report as defined above.

- Over Temperature Shutdown - The VMS controller shall continuously monitor the VMS housing's temperature sensors and shall automatically shut down the VMS if the internal cabinet temperature exceeds a safety threshold. This threshold shall have a default value of +140°F and shall be configurable at the controller. If the temperature exceeds that threshold, the controller shall trigger a warning notification event. This event shall completely turn off the LEDs.
- Controller Restart - When the VMS controller detects that it has been restarted due to a manual reset or error condition, it shall send a trap notification to the central system. It shall also automatically activate the NTCIP reset message if it is configured to do so.
- Power Loss - When the VMS controller detects that it has lost power, it shall automatically be indicated on the front panel LCD. If configured to do so, it shall send a trap notification to the central system and activate the NTCIP power loss message.
- Power System Failure - The VMS controller shall automatically monitor the power systems in the VMS and detect any failures. Any failures shall be reported on the front panel LCD and transmitted to the central system in the form of a trap.
- Door Opened - When the VMS controller detects that one of the VMS cabinet or control cabinet doors has been opened, it shall transmit a trap to the central system indicating which door has opened.
- Communication Loss - The VMS controller shall monitor the frequency of communication packets from the central system. If the controller detects that communication has not occurred between the controller and central system for longer than a user configured amount of time, the VMS controller shall automatically activate a communication loss message as defined by NTCIP. This communication loss message shall be configurable and may be disabled as allowed by NTCIP. A trap shall be sent to the central system.

Requirements for VMS Control Software

This section describes the minimum specifications for the VMS control software. The contractor shall provide all software, software media, licenses, and documentation necessary to install and operate a VMS control system that fully complies with the functional requirements herein, including incidental items required for operation that may have been inadvertently omitted.

General Specifications

VMS control software shall, at a minimum, comply with the following:

- Operate on desktop and laptop computers with Intel Pentium III or better processors and Microsoft Windows NT 4.0, 2000 Professional, or XP Professional operating systems

- Provide a user-friendly, multi-color, GUI
- Be written as a native 32-bit Windows program using Microsoft-certified software development tools (compilers, etc.)
- Be capable of controlling a network of at least 250 VMS
- Utilize a client-server architecture with the client connecting to the server via LAN or WAN and the server handling VMS communications
- Support VMS communications via any combination of dedicated hardwired serial network, fiber-optic network, dial-up telephone lines, leased phone lines, cellular telephone, CDPD, spread spectrum radio, Ethernet, or other
- Support VMS control, monitoring, and diagnostic functions
- Control VMS both remotely from a remote location and locally at the VMS site using a laptop computer
- Be accompanied by a software installation utility
- Furnish an operations manual that includes detailed instructions for configuring and using all parts of the software
- Contain an on-line help system that includes documentation for every screen or dialog box present in the software. The software shall also be context sensitive such that pressing the help button or [F1] key on any screen will launch the help page for that particular screen
- Be fully compliant with the communications protocol requirements of the NTCIP Special Provision

Software Security

VMS control software shall support the creation of user IDs and passwords for up to 100 system users. Only a System Administrator shall be permitted to create users and assign user access rights.

Before a system operator can use the VMS control software, the software shall request a username and password. If the correct username and password are not provided, access to the software shall be declined. The software shall lockout a user after failing to log in after a specified number of attempts.

Client-Server Architecture

The software shall be of a modular design including a server and multiple client modules. The server shall control all VMS communication and shall store all data and messages. The client software modules shall be capable of sending requests to and receive responses from the server over any TCP/IP-based network, including LANs and WANs. Separate clients shall be provided for each of the following software functions:

- Shell client that handles user login and logout and launching the other clients
- Display control client for controlling VMS messaging, monitoring system status, and performing VMS diagnostics
- Message editor client for creating and editing VMS messages
- Message scheduler client for creating time and date schedules for activating messages
- Administration client for VMS system configuration and administration

VMS Control

The VMS control software shall provide a user interface that presents the system's VMS status in both list and graphical formats. The software shall allow the VMSs to be grouped as needed by the administrator. The VMS list and map interfaces shall include only the VMSs for the group currently selected.

List and Map Interfaces

The VMS status list shall clearly display the following information about each VMS:

- VMS identification number, as "1" through "250"
- VMS name, in a descriptive text format
- Icon representation of the type of communication network used for the VMS (e.g. direct or dial-up)
- Name and priority level of message file being displayed
- Date and time of last communication between the control software and the VMS controller
- Error and warning status, including pixel errors, power failures, communication errors, etc.
- Configurable bitmaps that may be used to show all or parts of the system geographically
- Icons for each VMS that may be placed anywhere on the map
- Icon color changes to indicate the status of the VMS (i.e., yellow for warnings or red for errors)
- Icon flashes if a message is running on the VMS
- VMS name if mouse is placed over a VMS icon

Direct Control Operations

The user interface shall provide a means for users to directly perform the following tasks for each VMS:

- Send and activate stored messages from the libraries
- Blank the display
- Activate a quick message that is created immediately, not loaded from a library
- Send and activate schedules
- Retrieve both messages and schedules from the VMS
- Perform diagnostics of VMS subsystems such as power supplies, sensors, etc.
- Perform tests of pixels
- Monitoring of the VMS event log

Polling

The software shall have a feature to poll all or a set of VMS at predefined intervals or at a specific time-of-day. During a poll, the software shall retrieve the most recent status information from the VMS and present it to the user as appropriate in the list and map interfaces.

Scenarios

The administrator shall have the ability to create scenarios that act like macros or scripts to

automate a series of often repeated tasks. These scenarios shall have the ability to perform the following actions:

- Send and activate stored messages from the libraries
- Blank the display
- Send and activate schedules
- Perform diagnostics of VMS subsystems such as power supplies, sensors, etc.
- Perform tests of pixels

The scenarios shall be saved to libraries where system operators may activate them through the GUI. The scenarios shall also be capable of running automatically at scheduled times if programmed by the user.

System Monitoring

The software shall be capable of monitoring and displaying to the operator the contents of any communications in progress with VMS. The status of all outgoing and incoming data packets shall be displayed.

Multi-Vendor VMS Control

The software shall be capable of controlling any NTCIP-compatible VMS regardless of the manufacturer. The software shall support all mandatory and optional features typical in LED VMS. The software shall be configurable to enable or disable support for any standard optional NTCIP objects.

Message Creation and Editing

A VMS system operator shall be able to use the VMS control software to create, edit, name, and store message files.

Message Editor Defaults

The message editor shall automatically utilize the following default settings during the creation of new message files:

- Pixel spacing between adjacent lines of text
- Pixel spacing between adjacent text characters
- Display duration of a given message page
- Color palette to be used for color-capable VMSs
- Beacon activation status (for VMS that contain flashing beacons)
- Effect to be applied to text (e.g., static, scrolling, etc.)
- Effect rate, which shall determine the speed of scrolling messages
- Flash rate, which shall determine the speed of flashing messages
- Message priority classification
- Horizontal text justification supporting left, center, or right
- Vertical text justification supporting top, middle, and bottom

Message Priorities

User-definable default settings shall allow messages to be assigned a priority classification of:

- Emergency

- High
- Normal
- Low
- Minimal

A numeric priority range shall be assigned to each of these five priority classifications. The priority shall allow two different message files to be assigned the same classification. Within that classification, one message can be identified as having higher priority.

The message editor GUI shall present a scaled image of the VMS display matrix, including a complete and accurate representation of the display matrix type (full or line) and the number of display pixels. The VMS editor image shall actively show message content in a WYSIWYG format, while a new message is being created or an existing message is being edited.

The message editor shall provide the operator with the ability to program:

- The number of pages (one to six) that the message is to contain
- Message text
- Message graphics, including pixel-by-pixel editing, lines, area fill, block move, etc.
- Character font type(s) used to construct the message
- The amount of inter-line spacing, measured in pixels
- Horizontal message justification on the VMS display matrix including left, center, and right
- Vertical message justification on the VMS display matrix including top, middle, and bottom
- The type of entry effect (static or scrolling)
- Message page on time and off time
- Message scroll rate, if applicable
- The flash rate of all or part of a message page, if applicable
- Message priority status
- The display status of any flashing beacons mounted to the VMS

The message editor shall provide a method of incorporating data fields into a VMS message.

The following data fields shall be provided:

- Time, in 12 hour format
- Time, in 24 hour format
- Temperature, in °F and °C
- Vehicle speed, in kph and mph (for VMS sites that contain speed measurement equipment)
- Day of week
- Day of the month
- Month of the year
- Calendar year, in both two-digit and four-digit formats

The message editor shall provide a convenient means for the operator to:

- Insert, add or delete message text
- Paste graphics from other programs using the Windows clipboard
- Clear the contents of the editing page
- Save the message file under its existing name or a new name
- Delete a message file
- Save all changes

It shall be possible to store message files in both the VMS control computer memory and the VMS controller memory.

The system operator shall have the ability to print any message or library of messages.

Message Libraries

VMS control software shall support the creation, editing and storage of message libraries (file directories), which allow the system operator to categorize message files by:

- VMS matrix size
- Message subject matter

The library editor shall allow a system operator to:

- Create a new library
- Store the same message in multiple libraries
- Select a message from an existing library and edit the message contents
- Search libraries for messages with specified text in message name or contents
- Copy/Paste a message from one library to another
- Delete a message file from a library
- Rename a library
- Delete a library
- Save all changes

Schedule Creation and Editing

VMS control software shall support the creation, editing and storage of message schedules, which instruct the VMS controller to run specific messages at pre-determined times and dates.

Software shall contain an editor, which allows messages to be scheduled via:

- Month of the year
- Day of the week
- Day of the month
- Time of day

The schedule editor shall provide a means for the operator to:

- Create a new schedule
- Rename an existing schedule
- Delete a schedule
- Save all change

It shall be possible to store schedule files in both the VMS control computer memory and the VMS controller memory.

Display Fonts

The software shall support a minimum of 12 fonts for each model of VMS. These fonts shall be configurable by the system administrator. The fonts used shall be selectable from a library containing a minimum of 24 fonts provided by the software vendor. Each VMS model shall be capable of using a different set of fonts. The software shall automatically adjust the available fonts in the message editor based on the VMS model configuration.

The software shall include a font editor to allow the operator to create custom fonts. The font editor shall allow the administrator to create new fonts or modify existing fonts. The operator shall have the capabilities to graphically edit each character within a font in a pixel-by-pixel manner.

All fonts provided by the software vendor or created/modified by the administrator shall be downloadable to the VMS.

Event Logging

The software shall include an event logging system that logs all system events. Each logged event shall, at a minimum, include the following:

- Event ID number
- Operator who initiated the event
- Time and date that the event occurred
- Description of the event (e.g., “Diagnostic Test Performed”)
- Source of the event (e.g., VMS name)
- Additional data relevant to the event (e.g., “Failed pixel: (4, 73)”)

The events logged shall include, but not be limited to, the following:

- User login/logout
- Failed login attempts
- Communication failures
- Message and schedule activation or display blanking
- Diagnostics test results
- Warning events sent from the VMS
- Other system errors

The system operator shall have the ability to view, sort by category, and print the log file at any time.

System Configuration

The VMS control software shall allow users with security access rights to configure system parameters and functions. The basic sets of configurable settings include the following:

- VMS models and individual signs
- Communication networks
- System error/warning alarms
- User security rights

- System maps and VMS icon placement
- Default system options settings
- Default message parameters
- Message priority settings

VMS Configuration

At a minimum, the following information for each VMS shall be configurable in the VMS control software:

- VMS viewing area height and width (for full-matrix VMS)
- Number of lines and each line's height and width (for line-matrix VMS)
- Color capabilities (e.g., amber, tricolor, full-color, etc.)
- Site name
- VMS identification number
- Network address
- Communication parameters

Communication Settings

Communication network control shall include the ability to configure and modify VMS communication networks with the following parameters:

- Network type (e.g., direct serial, dial-up)
- Communication port (e.g. COM4)
- Baud rate (ranging from 1200 to 115,200)
- Hardware handshaking
- NTCIP subnetwork and transport protocols
- Communication retries and timeouts

System Alarms

Configurable settings shall allow the system administrator to determine which of the following events will trigger an audio and/or visual (on-screen) alarm:

- Communication failure
- Priority status conflict
- VMS restart
- Power supply failure
- Door open

User Administration

The administrator shall have the ability to add, remove and modify users and user's access rights? The access rights of each user shall be configurable to allow or deny access to any software feature.

System Maps

It shall be possible to configure each VMS group to appear on a map within the software. The administrator shall be able to use the software to select a map, identified as a bitmap

file, which can then be imported into the software. Each VMS shall have an icon that may be placed anywhere on the map.

Software Use and Reproduction Rights

The VMS manufacturer shall provide a VMS control software site license with the VMS supplied for this contract. Ten copies of the VMS control software shall be provided to the engineer on CD-ROM within 30 days of contract award. The Cabinet shall have the right to request or reproduce an unlimited number of software copies for use on the VMS system installed for this contract.

Requirements for NTCIP Conformance

This section describes the minimum specifications for the NTCIP communication capabilities of the VMS controller and VMS control software. The contractor shall provide all software, firmware, and services necessary to operate a VMS system that fully complies with the NTCIP functional requirements, including incidental items required for operation that may have been inadvertently omitted.

References

These specifications reference standards through their NTCIP designated names. Table 3 lists the current version of each of these standards.

Each NTCIP device covered by these project specifications shall implement the version of the applicable standard listed in Table 3. Refer to the NTCIP library at <http://www.ntcip.org> for information on the current status of NTCIP standards.

Table 3: NTCIP Document References

Document Number	Document Title	Document Status
NTCIP 1101:1996 and Amendment 1	<i>Simple Transportation Management Framework (STMF)</i>	Jointly Approved
NTCIP 1102 v1.12	<i>Octet Encoding Rules (OER) Base Protocol</i>	Recommended Standard
NTCIP 1103 v1.15	<i>Transportation Management Protocols</i>	User Comment Draft
NTCIP 1201:1996 and Amendment 1	<i>Global Object Definitions</i>	Jointly Approved
NTCIP 1203:1997 and Amendment 1	<i>Object Definitions for Dynamic Message Signs</i>	Jointly Approved
NTCIP 2001:1996 and Amendment 1	<i>Class B Profile</i>	Jointly Approved
NTCIP 2101:2001	<i>Point to Multi Point Protocol (PMPP) Using RS-232 Subnetwork Profile</i>	Jointly Approved
NTCIP 2103 v1.13	<i>Point-to-Point Protocol Over RS-232 Subnetwork Profile</i>	Jointly Approved
NTCIP 2104 v1.10	<i>Ethernet Subnetwork Profile</i>	Jointly Approved
NTCIP 2201 v1.14	<i>Transportation Transport Profile</i>	Jointly Approved

Document Number	Document Title	Document Status
NTCIP 2202:2001	<i>Internet (TCP/IP and UDP/IP) Transport Profile</i>	Jointly Approved
NTCIP 2301:2001	<i>Simple Transportation Management Framework (STMF) Application Profile</i>	Jointly Approved

Subnetwork Profiles

Each serial or modem port on each NTCIP device shall be configurable to support both NTCIP 2101 and NTCIP 2103. Only one of these profiles shall be active at any given time. Serial ports shall also support external dial-up modems.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2104.

The NTCIP devices may support additional subnet profiles at the manufacturer's option. At any one time, only one subnet profile shall be active on a given port of the NTCIP device. All response datagram packets shall use the same transport profile used in the request. The NTCIP device shall be configurable to allow a field technician to activate the desired subnet profile and shall provide a visual indication of the currently selected subnet profile.

Transport Profiles

Each serial or modem port on each NTCIP device shall be configurable to support both NTCIP 2201 and NTCIP 2202.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2202.

The NTCIP devices may support additional transport profiles at the manufacturer's option. Each NTCIP device shall support the receipt of datagram's conforming to any of the supported transport profiles at any time. Response datagram packets shall use the same transport profile used in the request.

Application Profiles

Each NTCIP device shall comply with NTCIP 2301 and shall meet the requirements for Conformance Level 1.

An NTCIP device may support additional application profiles at the manufacturer's option. Responses shall use the same application profile used by the request. Each NTCIP device shall support the receipt of application data packets at any time allowed by the subject standards.

Object Support

Each NTCIP device shall support all mandatory objects of all mandatory conformance groups as defined in NTCIP 1201 and NTCIP 1203.

Each NTCIP device shall support all mandatory objects in all optional conformance groups. All optional objects listed shall be supported.

The NTCIP devices shall support the optional conformance groups listed in Table 4.

Table 4: Optional Conformance Groups

Conformance Group	Reference
Time Management	NTCIP 1201
Timebase Event Schedule	NTCIP 1201
Report	NTCIP 1201
PMPP	NTCIP 1201
Font Configuration	NTCIP 1203
VMS Configuration	NTCIP 1203
MULTI Configuration	NTCIP 1203
MULTI Error Configuration	NTCIP 1203
Illumination/Brightness Control	NTCIP 1203
Scheduling	NTCIP 1203
VMS Status	NTCIP 1203
Status Error	NTCIP 1203
Pixel Error Status	NTCIP 1203

Table 5 lists objects that are considered optional in the NTCIP standards, but are required by this specification. Table 5 also indicates modified object value ranges for certain objects. Each NTCIP device shall provide the FSORS of all objects required by these specifications unless otherwise indicated in Table 5.

Table 5: Modified Object Ranges and Required Optional Objects

Object	Reference	Project Requirement
ModuleTable	NTCIP 1201 Clause 2.2.3	Shall contain a minimum of one row with moduleType = 3 (software).
maxTimeBaseScheduleEntries	NTCIP 1201 Clause 2.4.3.1	Shall be a minimum of 28
MaxDayPlans	NTCIP 1201 Clause 2.4.4.1	Shall be a minimum of 20
maxDayPlanEvents	NTCIP 1201 Clause 2.4.4.2	Shall be a minimum of 12
maxEventLogConfig	NTCIP 1201 Clause 2.5.1	Shall be a minimum of 50
eventConfigMode	NTCIP 1201 Clause 2.4.3.1	NTCIP Component shall support the onChange, greaterThanValue, and smallerThanValue event configurations
eventConfigLogOID	NTCIP 1201 Clause 2.5.2.7	FSORS
eventConfigAction	NTCIP 1201 Clause 2.5.2.8	FSORS
maxEventLogSize	NTCIP 1201 Clause 2.5.3	Shall be a minimum of 200
maxEventClasses	NTCIP 1201 Clause 2.5.5	Shall be a minimum of 16
eventClassDescription	NTCIP 1201 Clause 2.5.6.4	FSORS
maxGroupAddresses	NTCIP 1201 Clause 2.7.1	Shall be a minimum of 1
communityNamesMax	NTCIP 1201 Clause 2.8.2	Shall be a minimum of 3
NumFonts	NTCIP 1203 Clause 2.4.1.1.1.1	Shall be a minimum of 8

Object	Reference	Project Requirement
MaxFontCharacters	NTCIP 1203 Clause 2.4.1.1.3	Shall be a minimum of 255
defaultFlashOn	NTCIP 1203 Clause 2.5.1.1.1.3	VMS shall support the full range of these objects with step sizes between 0.1 and 0.5 seconds
defaultFlashOff	NTCIP 1203 Clause 2.5.1.1.1.4	VMS shall support the full range of these objects with step sizes between 0.1 and 0.5 seconds
defaultBackgroundColor	NTCIP 1203 Clause 2.5.1.1.1.1	VMS shall support the black background color
defaultForegroundColor	NTCIP 1203 Clause 2.5.1.1.2	VMS shall support the amber foreground color
defaultJustificationLine	NTCIP 1203 Clause 2.5.1.1.1.6	VMS shall support left, center, and right line justification
defaultJustificationPage	NTCIP 1203 Clause 2.5.1.1.1.7	VMS shall support top, middle, and bottom page justification
defaultPageOnTime	NTCIP 1203 Clause 2.5.1.1.1.8	VMS shall support the full range of this object with step sizes no larger than 0.5 seconds
defaultPageOffTime	NTCIP 1203 Clause 2.5.1.1.1.9	VMS shall support the full range of this object with step sizes no larger than 0.5 seconds
defaultCharacterSet	NTCIP 1203 Clause 2.5.1.1.1.10	VMS shall support the eight bit character set
dmsMaxChangeableMsg	NTCIP 1203 Clause 2.6.1.1.1.4	Shall be a minimum of 100
dmsMessageMultiString	NTCIP 1203 Clause 2.6.1.1.1.8.3	VMS shall support any valid MULTI string containing any subset of the MULTI tags listed in Table 6
dmsControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Shall support, at a minimum, the following modes: local, central, and centralOverride
DmsSWReset	NTCIP 1203 Clause 2.7.1.1.1.2	FSORS
dmsMessageTimeRemaining	NTCIP 1203 Clause 2.7.1.1.1.4	FSORS
dmsShortPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.8	FSORS
dmsLongPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.19	FSORS
dmsShortPowerLossTime	NTCIP 1203 Clause 2.7.1.1.1.10	FSORS
dmsResetMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsCommunicationsLossMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsTimeCommLoss	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsEndDurationMessage	NTCIP 1203 Clause 2.7.1.1.1.15	FSORS
dmsMemoryMgmt	NTCIP 1203 Clause 2.7.1.1.1.16	VMS shall support the normal and clearChangeableMessages memory management modes
dmsMultiOtherErrorDescription	NTCIP 1203 Clause 2.4.1.1.1.20	If the vendor implements any vendor-specific MULTI tags, the VMS shall provide meaningful error messages within this object whenever one of

Object	Reference	Project Requirement
		these tags generates an error
dmsIllumControl	NTCIP 1203 Clause 2.8.1.1.1.1	VMS shall support photocell and manual illumination control modes
dmsIllumNumBrightLevels	NTCIP 1203 Clause 2.8.1.1.1.4	Shall be a minimum of 255
dmsIllumLightOutputStatus	NTCIP 1203 Clause 2.8.1.1.1.9	FSORS
numActionTableEntries	NTCIP 1203 Clause 2.9.1.1.1	Shall be a minimum of 200
watcdogFailureCount	NTCIP 1203 Clause 2.11.1.1.1.5	FSORS
dmsStatDoorOpen	NTCIP 1203 Clause 2.11.1.1.1.6	FSORS
FanFailures	NTCIP 1203 Clause 2.11.2.1.1.8	FSORS
fanTestActivation	NTCIP 1203 Clause 2.11.2.1.1.9	FSORS
tempMinCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.1	FSORS
tempMaxCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.2	FSORS
tempMinSignHousing	NTCIP 1203 Clause 2.11.4.1.1.5	FSORS
tempMaxSignHousing	NTCIP 1203 Clause 2.11.4.1.1.6	FSORS

MULTI Tags

Each NTCIP device shall support the message formatting MULTI tags in Table 6. The manufacturer may choose to support additional standard or manufacturer-specific MULTI tags.

Table 6: Required MULTI Tags

MULTI Tag	Description
F1	Field 1 time (12 hr)
F2	Field 1 time (24 hr)
F8	Field 8 day of month
F9	Field 9 month
F10	Field 10 2 digit year
F11	Field 11 4 digit year
F1 (and /fl)	Flashing text on a line-by-line basis with flash rates controllable in 0.1 second increments.
Fo	Font
Jl2	Line Justification - Left
Jl3	Line Justification - Center
Jl4	Line Justification - Right
JP2	Page Justification - Top
JP3	Page Justification - Middle
JP4	Page Justification - Bottom
Mv	Moving text
Nl	New line
np	New page up to at least 5 instances in a message (i.e. up to at least 1 to 6 pages/frame in a message counting first page)

MULTI Tag	Description
Pt	Page times controllable in 0.1-second increments

DOCUMENTATION

NTCIP documentation shall be provided on CD-ROM and contain ASCII versions of the following MIB files in ASN.1 format:

- The version of each official standard MIB module referenced by the device.
- If the device does not support the full range of any given object within a standard MIB module, a manufacturer-specific version of the official standard MIB module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module except that it shall have the extension “man”.
- An MIB module in ASN.1 format containing any and all manufacturer specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- An MIB containing any other objects supported by the device

ACCEPTANCE TESTING

The manufacturer shall provide certification of NTCIP-compliance as part of the pre-build submittal documentation. This certification shall be in the form of a comprehensive test plan and completed test report as performed by either the ITS integrator or a third-party testing agency. The testing shall have been completed using industry accepted test tools such as the NTCIP Exerciser, Trevilon’s NTester, Intelligent Devices’ Device Tester, and/or Frontline’s FTS for NTCIP. Data capture files from the FTS software during the performance of the above testing shall be furnished upon request of the Engineer.

The Engineer may perform additional NTCIP testing if desired. This testing shall be conducted on a production VMS in the manufacturer’s facility during the factory acceptance test. The manufacturer shall provide a written NTCIP test procedure to the Engineer a minimum of 30 days prior to the NTCIP testing.

This item includes conduit and wiring on supporting structure. This item includes all costs for the manufacturer field engineer to perform on-site testing and setup. This item includes all costs for engineering analysis required in the VMS specifications.

INTERPRETATION RESOLUTION

If the Engineer or VMS manufacturer discovers an ambiguous statement in the standards referenced by this procurement specification, the issue shall be submitted to the NTCIP VMS Working Group for resolution. If the Working Group fails to respond within 90 days, the Engineer shall provide an interpretation of the specification for use on the project.

WARRANTY

The manufacturer shall supply at least a five year warranty of all components involved with the operations of the VMS sign. This shall include any tech support, replacement parts and

shipping of replacement parts. All warranties shall be transferable and shall start when the VMS Sign is commissioned on site by the manufacturer.

INSTALLATION

VMS shall be installed in accordance with the sign and truss manufacturers' specifications. The Contractor shall coordinate with the sign and truss manufacturers to resolve mechanical compatibility problems prior to fabrication of either item.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Variable Message Sign will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

VARIABLE MESSAGE SIGN- SIDE MOUNT

DESCRIPTION

Furnish and install Variable Message Sign in accordance with the plans, specifications and Standard Drawings.

This Specification describes minimum specifications for the VMS side mount required by the contract. The Contractor shall provide all materials, software, and services necessary to deploy a VMS side mount unit that fully complies with the requirements specified herein, including incidental items required for operation that may have been inadvertently omitted.

VMS shall be 3 lines by 10 characters with 1 pixel spacing between each character in 7x4 font size. VMSs shall use amber LED displays to generate 18" characters. VMS enclosures shall be a front access type.

VMSs shall communicate with the District 2 central control system using wireless router.

PRE-BUILD HARDWARE SUBMITTAL

A hardware submittal shall be provided prior to production of the equipment to verify that the design operates using the NTCIP. This test will be conducted by the KYTC ITS Integrator. The VMS manufacturer shall supply a VMS controller, power supply, three display modules, and any other equipment required for bench operation of the VMS unit. This equipment will be returned after testing is complete. The VMS manufacturer shall provide documentation and support for all NTCIP components unique to the design.

The pre-build submittal shall also include the following background information regarding the VMS manufacturer:

- Full corporate name

- Corporate address
- Contact person name, telephone number, fax number, and email address
- Names and qualifications of the primary project team members, including the following: sales person, project manager, product manager, application engineer, and manufacturing manager
- Number of years in business under the current corporate name
- Copy of the VMS manufacturer's in-house, quality management system. The in house quality management system shall be ISO 9001:2000 certified. Proof of this shall be submitted with the shop drawings
- Proof of certification of VMS manufacturer's welding procedure to ANSI/AWS D1.2/D1.2M-03 Structural Welding Code for Aluminum
- Proof of certification of all welders to ANSI/AWS D1.2/D1.2M-03 Structural Welding Code for Aluminum
- Name, phone number and address of ANSI/AWS Certified Welding Inspector
- General corporate literature
- VMS product literature

Documentation proving the VMS manufacturer complies with these specifications shall be provided with the pre-build technical submittal. This submittal shall also include references from three other states that have had NTCIP-compliant VMS from the manufacturer installed for a minimum of two years and project information for all of the manufacturer's VMS customers of the last five years, including:

- Equipment owner/operator agency name
- Contact person name, telephone number, fax number, and email address
- VMS unit name and location of operations control center (project name/number, roadway name/number, state, county, and country)
- VMS commissioning date (first date of successful on-site operation)
- VMS quantity
- VMS display pixel technology (LED, fiber optic, flip disk, etc.)
- VMS display matrix size (pixel rows by pixel columns) and type (full matrix, line matrix, or discrete character)
- VMS housing access type (walk-in, front, rear, or other specific access type)
- Communications protocol used (NTCIP or proprietary; if proprietary, provide a name or description)
- Type of communications backbone used (telephone, fiber optic, direct, etc.)
- NTCIP compliance test reports, including contact information, prepared by independent testing companies.

KYTC reserves the right to contact additional references. Any poor or unsatisfactory reference, as determined by KYTC in its sole and absolute discretion, may cause the LED VMS manufacturer to be rejected.

Experiences in the manufacture of other types of electronic sign products will not satisfy the requirements of this VMS specification. Other types may be, but are not limited to:

- Indoor signs of any size or type
 - Portable or mobile signs of any size or type
 - Neon signs
 - Back-lit signs
 - Rotating drum or plank signs
 - Blank out signs
 - Any type of sign that is not pixilated and cannot be programmed to display a nearly infinite quantity of messages
 - VMS that have a pixel technology comprised of something other than high-intensity LEDs such as incandescent lamps, liquid crystal, fiber optic, flip disk, flip-fiber combination, and flip-LED combination
 - VMS with a display matrix smaller than three lines of fifteen characters per line and having a character height smaller than 18 inches.
 - Outdoor electronic signs that are used for purposes other than roadway/motorway traffic management
- Failure to provide complete and accurate submittal information, as specified herein, shall be cause for rejecting the VMS manufacturer.

PRE-BUILD TECHNICAL SUBMITTAL

The VMS manufacturer shall provide a complete pre-build technical submittal within 60 days of contract award and shall not proceed with VMS manufacture until the Engineer has approved the submittal. The submittal shall include:

- All VMS manufacturer qualification information, as specified herein
- VMS shop drawings, including illustrations of the recommended installation method
- VMS structural calculations and certification by a registered professional engineer after the submittal has been approved
- VMS site riser diagram
- AC site power requirements, including the number of legs, current draw per leg, and maximum and typical site power consumption
- Major VMS schematics, including AC power distribution inside and outside the VMS, DC power distribution within the VMS, and control signal distribution inside and outside the VMS combine with 2nd bullet?
- Drawings of major VMS components, including LED display modules, driver boards, control/logic components, environmental control assemblies, VMS controller, control equipment cabinet assembly, and control cabinet mounting footprint combine with 2nd bullet?
- Catalog cut sheets for major VMS components, including front face paint material, polycarbonate face material, LEDs, regulated DC power supplies, circuit board conformal coating material, hookup wire, signal cable, surge suppression devices, load center, circuit breakers, utility outlets, VMS controller, ventilation/cooling fans, heaters, ventilation filter, thermostats, and any other major system components combine with 2nd bullet?
- Test reports and certification for all items identified in the “Product Testing” where? specifications herein

- VMS control software operator's manual
- Certificate of NTCIP compliance

VMS MANUFACTURER QUALIFICATIONS

This section describes the minimum qualifications required for a VMS manufacturer. A VMS manufacturer must meet these minimum qualifications prior to bidding. This section also details the product documentation that must be provided by the Contractor.

The VMS manufacturer for this contract shall:

- Have been in the business, under the same corporate name, of manufacturing large, outdoor, permanently mounted, LED VMS that are used to manage vehicular roadway traffic, for a minimum of ten years prior to the contract bid date. An LED VMS is defined as containing display pixels constructed solely of high-intensity, discrete LEDs.
- Have in operation a minimum of one hundred large, outdoor, permanently-mounted, LED VMS as defined above. Each of these VMS shall have been successfully operated for a minimum period of one year prior to the contract bid date.
- Have in operation, as of the contract bid date, a minimum of ten independently owned and operated VMS systems. Each of these systems shall contain a minimum of ten permanently mounted VMS that use the NTCIP as their primary communications protocol. Each of the VMSs shall be communicating over dial-up telephone, cellular telephone, spread spectrum radio, or fiber optic networks.
- Have previously demonstrated that their VMS controller is NTCIP compliant via compliance testing performed by an independent, third-party testing organization. The testing shall have been completed using industry accepted test tools such as the NTCIP Exerciser, Trevilon's NTester, Intelligent Devices' Device Tester, and/or Frontline's FTS for NTCIP.
- Utilize a documented, in-house, quality management system that has been in place for no less than two years prior to the contract bid date.
- Utilize a documented, certified, welding procedure. All welding shall be by an inert gas process in accordance with the AWS Standards, 2003 ANSI/AWS D1.2/D1.2M Structural Welding Code for Aluminum. The welders and welding procedures shall be certified by an ANSI/AWS Certified Welding Inspector to the above code. Proof of certification of all welders and applicable welding procedures shall be supplied with the submittals. The name, phone number and address of the ANSI/AWS Certified Welding Inspector who certified the welders and procedures shall also be provided with the submittals.

MATERIALS

This section describes the specifications for a full matrix, amber, aluminum, front access, VMS capable of displaying multiple lines of text with multiple characters per line.

The VMS shall be Daktronics VF-2420-27x60-18-A (30 degree angle), Skyline VMSLED-L-3-18F-27x55-I (30 degree angle) or approved equal.

The following specifications describe major VMS system components required, including:

- Full Matrix, Front access VMS
- VMS controller
- VMS controller enclosure
- VMS control software
- NTCIP communications protocol
- VMS manufacturer qualifications
- Product testing
- Product documentation

The VMS specification describes attributes common to all sizes of 18-inch, full matrix, front access VMS. For features and data that are unique to different VMS sizes, please refer to Table 1. This information can be inserted into the specification using the reference letters provided (A, B, C, etc.):

Table 1: VMS Dimensions

Pixel Rows {A}	Pixel Columns {B}	Cabinet Height {C}	Cabinet Width {D}	Cabinet Depth {E}	Weight Range (lbs) {F}
27	55 to 60	7'11" to 8'2"	14.7' to 15'	14" to 26"	1400 to 2250

MATERIAL, MANUFACTURING, AND DESIGN STANDARDS

VMS provided for this contract shall comply with the following standards. If no revision date is specified, the most recent revision of the standard applies:

- General VMS Requirements – The VMS shall be designed in accordance with *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (VMS), with NTCIP Requirements.*
- Aluminum Welding – The VMS housing shall be designed, fabricated, welded, and inspected in accordance with *ANSI/AWS D1.2-97 Structural Welding Code-Aluminum (1997).*
- Electrical Components – High-voltage components and circuits (120 VAC and greater) shall be designed, wired, and color-coded per the NEC.
- Protection from Environment – The VMS housing shall be designed to comply with type 3R enclosure criteria as described in *NEMA Standards Publication 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)*
- Product Electrical Safety - All VMS, associated equipment, and enclosures shall be listed by UL or an accredited third party testing organization, such as ETL Semko, and shall bear the organization’s mark. VMS shall be listed as conformant to UL 48 Standard for Electric Signs and UL 50 Enclosures for Electrical Equipment. Control equipment and enclosures shall be listed as conformant to UL 1433 Standard for Control Centers for Changing Message Type Electric Signs.
- Radio Frequency Emissions – All equipment shall be designed in accordance with Federal Communications Commission (FCC) Part 15, Subpart B as a “Class A” digital device.

- Maintenance Access and Safety – The VMS equipment provided shall be compliant with all relevant OSHA requirements.
- Structural Integrity – The VMS housing shall be designed and constructed to comply with all applicable sections of *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, Fourth Edition, 2001*, and the fatigue resistance requirements of *NCHRP Report 412, Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports*.
- Communication Protocols – The VMS controller hardware/firmware and VMS control software shall conform to the applicable NTCIP standards. Refer to the NTCIP section of this specification for detailed NTCIP requirements for this contract.

VMS CONSTRUCTION AND OPERATION

This section describes the minimum construction and operational requirements for the VMS to be supplied under this contract. The contractor shall provide all the materials, software, and services necessary to install VMS and associated equipment that fully comply with the functional requirements specified herein, including incidental items that may have been inadvertently omitted.

GENERAL

The VMS housing shall provide front service access for all LED display modules, electronics, environmental control equipment, air filters, wiring, and other internal VMS components.

The VMS shall contain a full display matrix measuring a minimum of [A] rows high by [B] pixel columns wide (see Table 1). The matrix shall display messages that are continuous, uniform, and unbroken in appearance to motorists.

Each display pixel shall be comprised of multiple monochrome amber LEDs. Other pixel technologies, such as fiber optic, flip disk, combination flip disk-fiber optic, combination flip disk-LED, liquid crystal, and incandescent lamp, will not be accepted. The centers of all adjacent pixels shall be spaced 2.6” to 2.75” apart, both vertically and horizontally.

The pixel matrix shall be capable of displaying alphanumeric character fonts measuring a minimum of 18 inches high to a maximum of the display matrix height.

The VMS shall be able to display messages composed of any combination of alphanumeric text, punctuation symbols, and graphic images across multiple frames.

Legibility

VMS messages shall, at a minimum, be legible from 150 ft to 900 ft from the VMS display face under the following conditions:

- When the VMS is mounted so its bottom side is positioned between five feet and 20 feet above a level roadway surface
- Whenever the VMS is displaying 18” high, alphanumeric text
- 24 hours per day and in most normally encountered weather conditions

- During dawn and dusk hours when sunlight is shining directly on the display face or when the sun is directly behind (silhouetting) the VMS
- When viewed by motorists that have 20-20 vision
- A range of 3 to 12 feet above the roadway surface
- **Must 9200 candelas per square meter**

Dimensions (See Table 1)

VMS housing dimensions shall not exceed [C] feet high by [D] feet wide. The front-to-back housing depth shall not exceed [E] ft at its widest point, including the rear ventilation hoods. VMS weight shall not exceed [F] pounds.

Power Requirement

VMS shall operate from one of the following power sources:

- 120 VAC, 60Hz single-phase, including neutral and earth ground
- 120/240 VAC, 60Hz single-phase, including neutral and earth ground
- Two legs of 120/208 VAC, 60Hz three-phase, including neutral and earth ground

VMS Construction

The VMS housing shall be constructed to have a neat, professional appearance. The housing shall protect internal components from rain, ice, dust, and corrosion in accordance with NEMA enclosure Type 3R standards, as described in *NEMA Standards Publication 250-2003, Enclosures for Electrical Equipment (1000 Volts Maximum)*. The VMS housing bottom shall contain small weep holes for draining any water that may accumulate due to condensation. Weep holes and ventilation/exhaust hoods shall be screened to prevent the entrance of insects and small animals.

External VMS component hardware (nuts, bolts, screws, standoffs, rivets, fasteners, etc.) shall be fabricated from hot dipped or mechanically galvanized steel, stainless steel, aluminum, nylon, or other durable, corrosion-resistant material suitable for roadway signage application.

VMS controller components shall operate in a nominal temperature range of -30°F to $+165^{\circ}\text{F}$ and a relative humidity range of 0 to 99%, non-condensing. VMS controller components shall not be damaged by storage at or temporary operational exposure to a temperature range of -40°F to $+185^{\circ}\text{F}$.

Except for the environmental control fans, VMS controller components shall be 100% solid-state.

Electrical components in the VMS controller shall be UL listed and meet all NEC codes applicable to VMS applications.

The presence of ambient radio signals and magnetic or electromagnetic interference, including those from power lines, transformers, and motors, shall not impair the performance of the VMS system. The VMS system shall not radiate electromagnetic

signals that adversely affect any other electronic device, including those located in vehicles passing underneath or otherwise near the VMS and its controller.

VMS Housing

The VMS housing shall have a NEMA 3R rating as a minimum. The VMS housing structural frame shall consist of aluminum extrusions made from 6061-T6 and/or 6063-T6 aluminum alloy. All sides of the VMS housing exterior, except the front, shall be covered with 0.125-inch thick aluminum sheets made from 5052-H32 aluminum alloy. This external aluminum skin shall be attached to the structural framework using a proven method of attachment.

VMS housing right, left, and rear walls shall be vertical. The top and bottom sides shall be horizontal.

VMS structural assembly hardware (nuts, bolts, washers, and direct tension indicators) shall be stainless steel or galvanized A325 high-strength steel and shall be appropriately sized for the application.

Welding

The aluminum skin shall be welded to the VMS cabinet frame. All exterior sheet seams shall be continuously seam welded to the VMS frame to form a single structure. Stitch welding shall be used on the interior of the cabinet to attach the aluminum skin sheets to the aluminum extrusion frame. The VMS housing shall be welded and inspected in accordance with the requirements of *ANSI/AWS D1.2-97 Structural Welding Code-Aluminum (1997)*. Compliance with this standard shall include, but shall not be limited to, the following:

- Welding shall be performed according to documented in-house welding procedures
- Personnel who perform welding on the VMS housing shall be certified to *AWS D1.2-97* for all weld types required for housing fabrication
- A CWI shall inspect VMS welding on a daily basis and shall complete written reports that document welding progress, weld integrity, and any corrective action taken. The VMS manufacturer shall archive these reports and make them available for review, upon request of the Engineer

Mounting Brackets

Multiple mounting brackets in the form of I-beam or Z-bar extrusions shall be bolted to the VMS housing exterior rear wall to facilitate attachment of the VMS to the support structure. Mounting brackets shall be:

- Extruded from aluminum alloy number 6061-T6
- Attached to the VMS using stainless steel or mechanically galvanized A325 high-strength steel bolts
- Attached to the VMS using direct tension indicators to verify that mounting hardware is tightened properly
- Attached to the VMS structural frame members, not just the exterior sheet metal

- Installed at the VMS manufacturer's factory
- Installed such that all bracket-to-VMS attachment points are sealed and water-tight
- Designed and fabricated such that the Contractor can drill into them without penetrating the VMS housing and compromising the housing's ability to shed water

The hardware used to attach the mounting brackets (nuts, bolts, washers, and direct tension indicators) to the VMS cabinet shall be stainless steel or galvanized A325 high-strength steel and shall be appropriately sized for the application. This hardware shall be supplied by the VMS manufacturer.

Lifting Hardware

For moving and installation purposes, multiple galvanized steel lifting eyebolts or lifting angles shall be attached to the top of the VMS housing. Eyebolt hardware or angles shall be installed at the VMS factory and attach directly to the VMS housing structural frame. All mounting points for eyebolts or angles shall be sealed to prevent water from entering the VMS housing. Lifting hardware, as well as the housing frame, shall be designed such that the VMS can be shipped and handled without damage or excessive stress being applied to the housing prior to or during VMS installation on its support structure. Special tools shall not be required. Removal of the eyebolts or angles shall not create holes and no replacement bolts or other hardware shall be necessary to seal the cabinet.

Front Face Construction

The VMS front face shall be constructed with multiple vertically or horizontal rigid panels, each of which supports and protects a full-height section of the LED display matrix. The panels shall be fabricated using aluminum sheeting on the exterior and polycarbonate sheeting on the interior of the panel.

To prevent open doors from blowing in wind, they shall each have a retaining latch mechanism to hold the door open at a 60 to 90- degree angle.

Each door shall form the face panel for a section of the sign. The LED modules shall be mounted to the door and be removable from the door when in the open position. Other sign components, such as power supplies, wiring, etc. shall be located inside the sign cabinet and be accessible through the door opening.

Each door shall contain a minimum of two latches to lock them in the closed position. These latches shall be captive to prevent them from falling off. They shall pull the door tight and compress a gasket located around the perimeter of each door. They shall also be capable of providing leverage to easily release the gasket seal when opening the doors. The gasket shall prevent water from entering the cabinet around the doors.

Front face panels shall provide a high-contrast background for the VMS display matrix. The aluminum mask of each panel shall contain an opening optimizing the contrast ratio for each LED pixel, and shall be finished with a matte-black, licensed-factory-applied, KYNAR 500 Resin, fluoropolymer-based coating system. The face shall be uniform in appearance and completely free from distortion, gouges or any other flaws or defects. A

certification shall be provided by the licensed-factory KYNAR 500 coater for all aluminum face materials. Openings shall be large enough to not block any portion of the viewing cones of the LEDs.

Each panel shall have a single polycarbonate sheet attached securely to the inside of the aluminum panel. The polycarbonate sheet shall cover all of the pixel openings. The polycarbonate shall be sealed to prevent water and other elements from entering the VMS. The polycarbonate shall contain UV inhibitors that protect the LED display matrix from the effects of UV light exposure and prevent premature aging of the polycarbonate. Polycarbonate sheets shall have the following characteristics:

- Tensile Strength, Ultimate: 10,000 psi
- Tensile Strength, Yield: 9,300 psi
- Tensile Strain at Break: 125%
- Minimum Tensile Modulus: 330,000 psi
- Minimum Flexural Modulus: 330,000 psi
- Minimum Impact Strength, Izod (1/8", notched): 17 ft-lbs/inch of notch
- Rockwell Hardness: M75, R118
- Heat Deflection Temperature Under Load: 264 psi at 270° F and 66 psi at 288° F
- Coefficient of Thermal Expansion: 3.9×10^{-5} in/in/F
- Specific Heat: 0.30 BTU/lb/F
- Initial Light Transmittance: 85% minimum
- Change in Light Transmittance, 3 years exposure in a Southern latitude: 3%
- Change in Yellowness Index, 3 years exposure in a Southern latitude: less than 5%

LED display modules shall mount to the inside of the VMS front face panels. Common hand tools shall be used for removal and replacement.

VMS front face borders (top, bottom, and sides), which surround the front face panels and LED display matrix, shall be coated with semi-gloss black KYNAR 500 resin by a licensed-factory coater to maximize display contrast and legibility.

Wind shall not cause distortion of the VMS front face in a manner that adversely affects LED message legibility.

Exterior Finish

VMS front face panels and front face border pieces shall be coated by a licensed-factory coater with semi-gloss black KYNAR 500 resin or an equivalent brand of oven-fired fluoropolymer coating, which has a minimum outdoor service life of 20 years. All other VMS housing surfaces, including the access doors and VMS mounting brackets, shall be natural mill-finish aluminum.

Service Access

The VMS housing shall provide safe and convenient access to all modular assemblies, components, wiring, and subsystems located within the VMS housing. All internal components and front face panels shall be replaceable by a single technician from inside the VMS enclosure.

Utility Receptacles

The VMS housing shall contain a utility outlet circuit consisting of a minimum of three 15 A NEMA 15-R, 120 VAC duplex outlets, with ground-fault circuit interrupters. One outlet shall be located near each end of VMS housing interior, and the third outlet shall be located near the center of the housing.

LED Display Modules

The VMS shall contain LED display modules that include LED pixel array boards and mounting hardware. These modules shall be mounted adjacently in a two-dimensional array to form a continuous LED pixel matrix. Each LED display module shall be constructed as follows:

- Each LED display module shall consist of one LED pixel board and one LED driver circuit board that can be used for controlling multiple displays. The LED driver circuit board shall be mounted to the back of the LED pixel board using durable non-corrosive hardware. LED driver boards shall be electrically connected via one or more header-type connectors. The header connectors shall be keyed such that the boards cannot be connected incorrectly.
- LED display modules shall be mounted to the rear of the display's front face panels using durable non-corrosive hardware. No tools shall be required for module removal/replacement. The modules shall be mounted such that the LEDs emit light through the face panel's pixel holes and such that the face panel does not block any part of the viewing cone of any of the LEDs.
- LED display module power and signal connections shall be via a quick-disconnect, locking-type connector. Removal of a display module from the VMS, or a pixel board or driver circuit board from its display module, shall not require a soldering operation.
- Removal or failure of any LED module shall not affect the operation of any other LED module or VMS component. Removal of one or more LED modules shall not affect the structural integrity of any part of the VMS.
- LED display modules shall be designed to that it is not possible to mount an LED display module upside-down or in an otherwise incorrect position within the VMS display matrix.
- All LED display modules, LED pixel boards and driver circuit boards shall be identical and interchangeable throughout the VMS.

LED Pixel Boards

Each LED pixel board shall be composed of a printed circuit board to which LED pixels are soldered. The LED pixel boards shall conform to the following specifications:

- LED pixel boards shall be manufactured using a laminated fiberglass printed circuit board.

- Each LED pixel circuit board shall contain a minimum of 45 LED pixels configured in a two dimensional array. The pixel array shall be nine pixels high by five pixels wide.
- The distance from the center of one pixel to the center of all adjacent pixels, both horizontally and vertically, shall be 2.6-inches to 2.75 inches.
- Each pixel shall consist of a minimum of two independent strings of discrete LEDs. All pixels shall contain an equal quantity of LED strings.
- The failure of an LED string or pixel shall not cause the failure of any other LED string or pixel in the VMS.
- Pixels shall contain the quantity of discrete LEDs needed to output a minimum intensity of 40 candelas when operated within the forward current limits. This shall yield an overall minimum luminous intensity for the sign face of 9,200 Cd/m².
- Each LED pixel shall not consume more than 1.5 watts.
- All exposed metal on both sides of the LED pixel board, except connector contacts, shall be protected from water and humidity exposure by a thorough application of conformal coating. Bench level repair of individual pixels, including discrete LED replacement and conformal coating repair, shall be possible.
- All LED pixel boards shall be identical and interchangeable throughout the VMS.

Discrete LEDs

VMS pixels shall be constructed with discrete LEDs manufactured by Agilent Technologies or approved equal. Discrete LEDs shall conform to the following specifications:

- LEDs used in VMS shall be from the same manufacturer and of the same part number.
- LEDs 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 in a T1-3/4 style LED package.
- LEDs shall emit amber light that has a peak wavelength of 590 ± 5 nm. LEDs shall be obtained from no more than two consecutive color bins. The LED manufacturer shall perform color sorting of the bins.
- All pixels shall have equal color and on-axis intensity. All pixels, including spare parts, shall have equal color and on-axis intensity. The method used to provide the equal color and intensity shall be included in the submittals and approved by the Engineer.
- The various LED color and intensity bins shall be distributed evenly throughout the VMS and shall be consistent from pixel to pixel. Random distribution of the LED bins shall not be accepted.
- LEDs shall have a nominal viewing cone of 30° with a half-power angle of 15° measured from the longitudinal axis of the LED. Viewing cone tolerances shall be as specified in the LED manufacturer's specifications and shall not exceed $\pm 3^\circ$.

- The LEDs shall be driven with a nominal 20 mA current.

LED Driver Circuit Board

An electronic driver circuit board shall be provided for each LED pixel module and shall individually control all pixels on that module. The driver circuit boards shall conform to the following specifications:

- LED driver boards shall be manufactured using a laminated fiberglass printed circuit board.
- All exposed metal on both sides of the LED driver board, except connector contacts, shall be protected from water and humidity exposure by a thorough application of acrylic conformal coating or silicone resin conformal coating.
- Bench level repair of individual components, including conformal coating repair, shall be possible.
- LED driver boards shall be microprocessor-controlled and shall communicate with the VMS controller via a wire or fiber optic communication network using an addressable network protocol. The microprocessor shall process commands from the VMS controller to display data, perform diagnostic tests, and report pixel and diagnostic status.
- Constant current LED driver ICs shall be used to prevent LED forward current from exceeding the maximum discrete LED drive current when a forward voltage is applied.
- LED pixels shall be directly driven using PWM of the drive current to control the display intensity. This LED driver circuitry shall vary the current pulse width to achieve the proper display intensity levels for all ambient light conditions. The drive current pulse shall be modulated at a frequency high enough to provide flicker-free operation and a minimum of 200 brightness levels.
- LED driver boards shall be capable of receiving updated display data at a minimum rate of ten frames per second from the VMS controller.
- LED driver boards shall be capable of receiving multiple power feeds from a minimum of two independent power supplies.
- LED driver boards shall contain a microprocessor-controlled power regulation circuit that controls the voltage applied to the LED strings. The power regulation circuit shall automatically adjust the forward voltage of the LEDs to optimize power consumption efficiency as the temperature changes. Indicator LEDs shall be provided to indicate the status of each power source. The power regulation circuit shall monitor the incoming power supply feeds and automatically select one or more to power the LEDs. If any of the incoming power sources fail, the power system shall automatically switch to one or more of the remaining power sources. The voltage of each power input shall be measured to the nearest tenth of a volt and reported to the VMS controller upon request.
- LED driver boards shall contain a temperature sensor and shall report the temperature to the VMS controller upon request.

- The LED driver circuitry shall be capable of detecting that individual LED strings or pixels are in an off state and shall report the pixel status to the VMS controller upon request.
- Each LED driver board shall contain a seven segment numeric LED display that indicates the functional status of the driver and pixel boards. At a minimum, it shall indicate error states of the LED pixels and communication network. The indicator shall be positioned such that a maintenance technician can easily view the status code for diagnostic purposes. The status codes shall also be reported to the VMS controller upon request.
- All driver circuit boards shall be identical and interchangeable throughout the VMS.
- Removal or failure of a single driver circuit board shall not affect the performance of any other LED display module in the VMS.
- Individual addressing of each driver circuit shall be configured via the communication wiring harness and connector. No on-board addressing jumpers or switches are allowed.

Regulated DC Power Supplies

Regulated DC power supplies shall be identical and interchangeable throughout the VMS and shall conform to the following specifications:

- Output variance: $\pm 10\%$
- Nominal maximum output power rating: 1000 watts
- Operating input voltage range: 90 to 260 VAC minimum
- Operating temperature range: -30°F to $+165^{\circ}\text{F}$ minimum
- Maximum output power rating shall be maintained over a minimum temperature range of -30°F to $+140^{\circ}\text{F}$
- Power supply efficiency: 75% to 80% minimum
- Power supply input circuit shall be fused
- Automatic output shut down and restart capability if the power supply overheats or one of the following output faults occurs: over-voltage, short circuit, or over-current
- Power supplies shall be UL listed
- Printed circuit boards shall be protected by an acrylic conformal coating or silicone conformal coating

The LED pixel display modules shall be powered with auto-ranging, regulated, switching, power supplies that convert the incoming AC to DC at a nominal voltage of 12 or 24 volts DC. Power supplies shall be wired in a redundant parallel configuration that uses multiple supplies for the VMS display matrix.

Power supplies within each pair shall be redundant and rated such that if one supply fails, the remaining supply shall be able to operate 100% of the pixels in that display region at 100% brightness when the internal VMS air temperature is $+140^{\circ}\text{F}$ or less.

The power supplies shall be sufficient to maintain the appropriate LED display intensity throughout the entire operating input voltage range.

The output of each power supply shall be connected to multiple circuits that provide power to the LED modules. Each output circuit shall not exceed 15 A.

Each group of power supplies shall be monitored by a microprocessor-controlled circuit. This circuit shall monitor the voltage of each power supply and the status of each output circuit's fuse. The power supply voltages and fuse states shall be reported via a CAN communication network to the VMS controller upon request.

Environmental Monitoring Systems

The VMS shall include sensors that monitor external light level, internal and external temperature, and internal humidity.

Sensors that measure the outdoor ambient light level and the outdoor ambient temperature at the VMS site shall be mounted in-line with the VMS housing walls. This ambient light and temperature measurement system shall consist of three electronic light sensors.

Two of the light sensors shall be placed such that they measure the ambient light levels striking the front and rear of the VMS. The third light sensor shall be mounted to the floor of the VMS housing and shall face the ground. The VMS controller shall continuously monitor the light sensors and adjust the LED display matrix intensity to a level that displays a legible message on the VMS face.

A minimum of one ambient temperature sensor shall be mounted to either the rear wall or bottom of the VMS housing and shall be placed such that it is never in direct contact with sunlight. The external temperature sensor reading shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

A minimum of one temperature sensor shall be mounted near the top of the VMS interior. The sensor shall measure the temperature of the air in the cabinet over a minimum range of -40°F to +176°F. The internal temperature sensor output shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

The VMS shall contain one sensor that measures the relative humidity of the air inside the VMS cabinet. The sensor shall monitor the humidity from 0 to 100%. The humidity sensor output shall be continuously monitored by the VMS controller and shall be reported to the VMS control software upon request.

Interior VMS Environmental Control

The VMS shall contain systems for internal ventilation, face panel fog and frost prevention, and safe over-temperature shutdown.

Housing Ventilation/Exhaust System

The VMS shall contain a ventilation system designed to keep the internal VMS air temperature lower than +140°F when the outdoor ambient temperature is +115°F or less.

One filtered air intake port shall be provided for each exhaust port. Intake ports shall be located on the rear VMS wall. Each intake port shall be covered with a filter that removes airborne particles measuring 500 microns and larger in diameter. Each exhaust port shall be located near the top of the rear VMS wall.

One or more ball bearing-type fans shall be mounted at each intake port. These fans shall create positive pressure inside the VMS cabinet.

Fans and air filters shall be removable and replaceable from inside the VMS housing.

An aluminum hood shall cover each air intake and exhaust port. Openings shall be screened to prevent the entrance of insects and small animals. All intake and exhaust hoods shall be sealed to prevent water from entering the VMS.

A thermostat or multiple temperature sensors shall be used to activate the ventilation system.

A manual override timer switch shall be located inside the access door or centrally located to manually activate the ventilation system. The switch shall be adjustable from zero to four hours.

Front Face Panel Defog/Defrost System

The VMS shall contain a defog/defrost system that automatically warms the VMS front face when the internal VMS relative humidity is near condensation levels. This system shall keep the front face polycarbonate panel free of frost and condensation. The heat generated by the defog/defrost system shall not damage any part of the VMS. A thermostat or temperature sensors shall automatically activate the defog/defrost system.

Over Temperature Safety Shutdown

The VMS shall automatically shut down the LED modules to prevent damaging the LEDs if the measured internal cabinet air temperature exceeds a maximum threshold temperature. The threshold temperature shall be configurable and shall have a default factory setting of 140°F.

VMS Controller Signal Interface

For systems with controllers mounted inside the VMS cabinet, the controller to VMS interface shall use shielded Category 5 copper cable. There shall be an access panel for laptop connections mounted at the base of the truss base for remote access to the VMS controller.

Wiring and Power Distribution

Power and Signal Entrances

Two threaded conduit hubs shall be located on the rear wall of the VMS housing. One hub shall be for incoming AC power and the other shall be for incoming VMS signal cabling or a communications line.

Load Center

The VMS shall contain a power load center and circuit breakers that meet the following minimum requirements:

- Service entrance-rated
- Minimum of 20 circuit breaker mounting positions
- Short circuit rating of 22,000 amps for the main breaker
- Short circuit rating of 10,000 amps for the branch circuit breakers
- UL listed load center and circuit breakers

Internal Wiring

Wiring for the LED display module control, environmental control circuits, and other internal VMS components shall be installed in the VMS housing in a neat and professional manner. Wiring shall not impede the removal of display modules, power supplies, environmental control equipment, or other VMS components. Wires shall not make contact with or bend around sharp metal edges. All wiring shall conform to the NEC.

Earth Grounding

The VMS manufacturer shall provide one lug to be used as an earth ground that is electrically bonded to the VMS housing. The lug shall be installed near the power entrance location on the VMS housing rear wall. The Contractor shall provide the balance of materials and services needed to properly ground the VMS to earth. All earth grounding shall conform to the NEC.

Transient Protection

The VMS controller signal and power inputs shall be protected from electrical spikes and transients as follows:

- Site AC Power - The AC power feed shall be protected at the load center by a parallel-connected surge suppressor rated for a minimum surge of 10 kA.
- Control Equipment AC Power - A series-connected surge suppressor capable of passing 15 amps of current shall protect the VMS controller and other control and communication equipment. This surge suppressor shall conform to the following requirements:
 - Withstand a peak 50,000 ampere surge current for an 8x20 μ s wave form
 - Maximum continuous operating current of 15 amps at 120 VAC, 60 Hz
 - Series inductance of 200 micro henrys (nominal)
 - Temperature range of -40°F to +158°F
 - Approximate dimensions of 3" Wide x 5" Long x 2" High
 - The device shall be UL-1449 listed
 - UL 1449 surge rating of 400 V or less

- Communication Signals- Transient voltage surge suppressors shall protect all communication signals connecting to the control equipment from off-site sources using other cables. Transient voltage surge suppressors shall protect all communication lines used to pass data between the VMS controller and VMS.

PRODUCT TESTING

The VMS manufacturer shall provide documentation indicating that the VMS has been tested to the standards below. It is acceptable for the testing to be performed on scale-sized versions of the actual VMS provided that the test unit is functionally and structurally equivalent to the full size VMS.

Third party test reports shall be submitted for the following:

- *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements* – Section 2, Environmental Requirements. Test report shall detail results of mechanical vibration and shock, electrical noise and immunity, temperature, and humidity.
- UL 48 Standard for Electric Signs, UL 50 Enclosures for Electrical Equipment, and UL 1433 Standard for Control Centers for Changing Message Type Electric Signs. The UL report numbers for all VMS and control equipment manufactured by the VMS manufacturer shall be listed by UL or an accredited third party testing organization, such as ETL Semko, and shall bear the organization's mark.
- NTCIP 1201:1996, NTCIP Global Object Definitions (including Amendment 1)
- NTCIP 1203:1997, Object Definitions for Dynamic Message Signs (including Amendment 1)
- NTCIP 2101:2001, Point to Multi-Point Protocol Using RS-232 Subnetwork Profile.
- NTCIP 2103 (Draft v1.13), Point-to-Point Protocol Over RS-232 Subnetwork Profile.

The test reports shall include testing of sub-network communications, objects in all mandatory conformance groups, and a subset of the remaining objects as deemed appropriate by the testing organization.

When required by the testing standards, the tests shall be performed by independent third party testing facilities. Certified test reports signed by the testing facility personnel shall be submitted for verification by the Engineer.

VMS HOUSING STRUCTURAL CERTIFICATION

A Registered Professional Engineer shall analyze the VMS structural design and shall certify that the VMS is:

- Engineered to 2001 AASHTO and NCHRP Report 411 specifications for basic wind speeds up to 140 mph and centerline sign heights up to 40 feet.
- Engineered to withstand group loading combinations as outlined in *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaries and Traffic Signals, Fourth Draft, 2001* including: VMS weight, repair personnel and equipment, snow (40 psf), ice and wind loads, and shall also meet strength requirements for truck-induced gusts as specified in *NCHRP Report 412*.

- Compliant with the fatigue resistance requirements of *NCHRP Report 412, Fatigue-Resistant Design of Cantilevered Signal, Sign, and Light Supports*.
- Capable of withstanding the temporary effects of being lifted by the lifting eyebolts or lifting angles provided

The Professional Engineer shall analyze the complete VMS structural design. This includes the housing, mounting brackets, lifting eyebolts/angles, and bracket-to-housing mounting hardware (nuts, bolts, washers, direct tension indicators, etc.) provided by the VMS manufacturer. Analysis shall include, but shall not be limited to:

- The quantity and type of mounting brackets to be provided
- The quantity and type of hardware (nuts, bolts, washers) used to attach the mounting brackets to the VMS
- Verification that no problem due to the use of dissimilar metals will exist and/or affect the structural integrity of the VMS-to-bracket attachment points
- A recommendation of the number of attachment points and the attachment locations that the installing contractor should use when mounting the VMS to its support structure
- The quantity and type of lifting eyebolts or lifting angles to be provided

The VMS manufacturer shall include a sealed and signed copy of the Professional Engineer's P.E. certification and all supporting calculations after the submittal is approved by KYTC.

Requirements for VMS Controllers

This section describes the minimum specifications for the VMS controllers to be provided with this contract. Each VMS shall include a VMS controller and associated equipment. The contractor shall provide all the materials, software, and services necessary to install VMS controllers and associated equipment that fully comply with the functional requirements specified herein, including incidental items required for operation that may have been inadvertently omitted.

General Requirements

Each VMS shall be controlled and monitored by an individual VMS controller. One controller shall be provided for each VMS. The VMS controller shall be a stand-alone microprocessor-based system, which does not require continuous communication with VMS control software in order to perform most VMS control functions.

The VMS controller shall meet the following operational requirements:

- Communicate using the NTCIP protocol
- Contain memory for storing changeable and permanent messages, schedules, and other necessary files for controller operation
- Include a front panel user interface with LCD and keypad for direct operation and diagnostics
- Contain a minimum of three NTCIP-compliant RS232 communication ports
- Contain a minimum of one NTCIP-compliant Ethernet port with RJ45 connector

- Contain a built-in Hayes-compatible modem with standard RJ11 connector
- Contain VMS-specific control firmware (embedded software) that monitors all external and internal sensors and communication inputs and controls the display modules as directed by external control software and the front panel interface

NTCIP shall be supported in the VMS controller. External protocol converter or translator devices shall not be allowed

OR

The VMS controller shall be a multiple-sourced, non-proprietary, 19-inch rack-mountable, Type 2070 traffic controller conforming to the latest CALTRANS Specifications and shall be provided with NTCIP-compliant, resident software stored in non-volatile memory. The 2070 shall perform all communication, control and feedback functions and shall be the only VMS controller. No intermediate control device shall be used.

Controller Location

For systems with controllers mounted inside the VMS cabinet, the controller to sign interface shall use shielded Category 5 copper cable. There shall be an access panel for laptop connections mounted at the base of the truss base for remote access to the sign controller.

Environmental

The VMS controller shall meet the following requirements defined in *NEMA Standards Publication TS 4, Hardware Standards for Dynamic Message Signs (DMS), with NTCIP Requirements*.

VMS Controller Operational Requirements

This section describes the VMS Controller Operational Requirements

Front Panel User Interface

The VMS controller's front panel shall include a keypad and LCD. These devices shall be used to perform the following functions with the VMS controller and VMS:

- Monitor the current status of the VMS controller, including the status of all sensors and a monochromatic WYSIWYG representation of the message visible on the display face
- Perform diagnostics testing of various system components, including pixels, power systems and sensors
- Activate messages stored in memory
- Configure display parameters, including display size and colors
- Configure communications port settings and NTCIP options

The front panel interface shall also include:

- Power switch to turn the controller on and off
- LED power ON indicator

- Local/Remote switch that places the controller in local mode such that it can be controlled from the front panel interface
- LED to indicate state of the Local/Remote mode switch
- Reset switch to quickly restart the controller
- LED “Active” indicator that blinks when the controller is operating correctly
- LED to indicate when any of the NTCIP communication channels are active

Memory

The VMS controller shall have non-volatile, electronically-changeable memory. This memory shall be flash or battery-backed static RAM ICs that retain the data in memory for a minimum of 30 days following a power loss. This changeable memory shall be used to store messages and schedules. The controller memory shall be capable of storing a minimum of 100 changeable messages in non-volatile RAM.

Internal Clock

The VMS controller shall contain a computer-readable clock that has a battery backup circuit. The battery shall keep the clock operating properly for at least five years without external power, and the clock shall automatically adjust for daylight savings time and leap year using hardware, software, or a combination of both. The clock shall be set electronically by the VMS controller microprocessor and shall be accurate to within one minute per month.

Communications

All remote communication ports shall be NTCIP-compatible as defined in the “Requirements for NTCIP Compatibility” section of these specifications.

Communication Modes

VMS controller shall be capable of receive instructions from and provide information to a computer containing VMS control software using the following communication modes:

- Remotely, via direct or dial-up communications, with a remote computer. The system communications backbone and all field modems and signal converters shall provide the VMS controller with an RS232 signal.
- Locally, via direct connection with a laptop computer that is connected directly to the VMS controller using an RS232 null modem connection.

Serial Communication Ports

The VMS controller shall contain a minimum of three NTCIP-compatible RS232 communication ports. These ports shall support multiple communication interfaces, including, but not limited to, direct null-modem (for local laptop control), dial-up and leased-line modems, radio systems, cellular modems, and fiber optic modems. The RS232 ports shall all have standard DB9M connectors.

The baud rate, connection type, and NTCIP communication protocol shall be configurable. Each port shall support all standard serial baud rates ranging from 1200 to 115,200 baud. Each port shall be capable of supporting either NTCIP 2101 (PMPP) or NTCIP 2103 (PPP) sub network profiles. Each port shall also be capable of supporting

either NTCIP 2201 (Null) or NTCIP 2202 (Internet) transport profiles. Only one each of the transport and sub network profiles shall be active at any time on a port.

Ethernet Port

The VMS controller shall contain a minimum of one 10/100Base-T Ethernet communication port. This port shall be available for optional use for communicating from the central control system to the VMS controller when an Ethernet network is available. The Ethernet port shall have a standard RJ45 connector.

Communications via the Ethernet port shall be NTCIP-compatible using the NTCIP 2202 Internet transport profile and the NTCIP 2104 Ethernet sub network profile. This shall permit the controller to be operated on any typical Ethernet network using TCP/IP and UDP/IP.

Dial-Up Modem Communication Port

The VMS controller shall include one dial-up modem. The modem port shall have a standard RJ11 connector.

The modem shall be capable of supporting either NTCIP 2101 (PMPP) or NTCIP 2103 (PPP) sub network profiles. The modem port shall also be capable of supporting either NTCIP 2201 (Null) or NTCIP 2202 (Internet) transport profiles. Only one each of the transport and sub network profiles shall be active at any time on the port.

The modem shall be configurable to support both incoming and outgoing calls as supported by NTCIP. The modem shall support a minimum communication speed range from 1200 baud to 28,800 baud. The modem shall support the following protocols at a minimum: AT command set, MNP5, MNP10, and V.42bis.

Controller Addressing

The VMS controller shall use whatever addressing scheme is appropriate for the NTCIP network types used for communications. The controller addressing shall be configurable through the front panel user interface.

NTCIP 2101 (PMPP) networks shall be configured with an address in the range 1 to 255 with a default address of 1. NTCIP 2104 (Ethernet) networks shall use a static IP address. Both the IP address and subnet shall be configurable. NTCIP 2103 (PPP) networks shall not require network addressing.

Transient Protection

The RS232 and Ethernet communication ports in the VMS controller shall be protected with surge protection between each signal line and ground. The telephone communication port shall be protected by a series/parallel two-stage suppression device that protects the modem from over-voltage and over-current conditions.

VMS Control Outputs

The VMS controller shall transmit and receive data packets to and from the VMS via dedicated communication cables. These cables shall be either multi-mode fiber optic cable with ST-style connectors or stranded, twisted pair, optically-coupled, 300 V, shielded cable. This network will communicate with all sensors, drivers, and other devices utilizing a CAN bus network running throughout the VMS.

Data transferred shall include pixel states, sensor values, and I/O readings from various devices, such as door sensors and power supply monitors. Pixel data shall include the information to be displayed on the VMS face as well as diagnostic data retrieved from the LED drivers.

Messaging

The VMS controller shall have the ability to display messages on the VMS display face

Message Presentation on the VMS Display Matrix

The VMS controller shall control the LED drivers such that the appropriate message is displayed on the VMS. At a minimum, the VMS controller shall support the following features

- *Display of alpha numeric characters, including letters, numbers, and punctuation*
- Selection of particular character fonts
- Horizontal alignment of text on the display, including left, center, and right justification
- Vertical alignment of text on the display, including top, middle, and bottom justification
- Adjust the spacing horizontally between characters or vertically between lines of text
- Alternate between pages of a multiple-page message
- Display graphic bitmaps of various sizes ranging from very small to the size of the entire VMS matrix

Message Effects

The VMS shall be capable of displaying messages using the following types of effects:

- **Static Message** – The selected message is displayed continuously on the VMS face until the VMS controller blanks the VMS or causes the display of another message
- **Flashing Message** – All or part of a message is displayed and blanked alternately at a rate between 0.1 seconds and 9.9 seconds. The flash rate shall be user programmable in increments of 0.1 seconds
- **Scrolling Message** – The message moves across the display face from one side to the other. The direction of travel shall be user selectable as either left-to-right or right-to-left with variable display speeds.
- **Multiple-Page Message** – A message contains up to six different pages of information, with each page filling the entire pixel matrix. Each page's display time shall be user programmable from 0.1 seconds to 25.5 seconds, and adjustable in increments of 0.1 seconds.

Message Activation

Messages shall be capable of being activated on a VMS in three ways:

- Manual – An operator using the front panel LCD/keypad interface or NTCIP-compatible control software manually instructs a particular message to be activated.
- Schedule – The internal time-based scheduler in the VMS shall be capable of being configured to activate messages at programmable times and dates. Prior to activation, these messages and their activation times and dates shall be configured using the control software.
- Events – If configured by the control software, certain events, like a power loss, may trigger the activation of pre-configured messages when they occur.

A displayed message shall remain on the VMS until one of the following occurs:

- The duration of the message expires
- The controller receives a command to change the message
- The controller receives a command to blank the VMS
- The schedule stored in the controller's memory indicates that it is time to activate a different message
- A special event, such as a loss of communication, occurs that is linked to message activation

It shall be possible to confer a "priority" status onto any message, and a command to display a priority message shall cause any non-priority message to be overridden.

Schedule Activation

The VMS controller shall support the activation of messages based on a time/date-based schedule. The format and operation of the message scheduler shall be per the NTCIP 1201 and NTCIP 1203 standards.

Display of Alphanumeric Text

The VMS controller shall support the storage and use of a minimum of 12 fonts with which messages can be formatted and displayed. Each font shall support up to 255 characters. All text font files shall, at a minimum, include the following characters:

- The letters "A" through "Z", in both upper and lower case
- Decimal digits "0" through "9"
- A blank space
- Eight directional arrows
- Punctuation marks, such as: . , ! ? - ' ' " " : ;
- Special characters, such as: # & * + / () [] < > @

The VMS manufacturer shall equip the VMS controller with the fonts in Table 2 preinstalled. The controller shall support changing or replacing these fonts from the central software using NTCIP.

Table 2: Fonts

Font Name	Character Height	Character Width (avg.)	Variable or Fixed Width	Stroke Width
7x4	7	4	Variable	Single
7x5	7	5	Fixed	Single
7x6	7	6	Variable	Double
Graphic 7	7	N/A	Variable	N/A
8x4	8	4	Variable	Single
8x6	8	6	Variable	Double
9x6	9	6	Variable	Double
11x7	11	7	Fixed	Double
14x8	14	8	Fixed	Double
14x10	14	10	Variable	Triple
16x8	16	8	Variable	Double
16x10	16	10	Variable	Triple

Display of Graphic Images

The VMS control software shall support the inclusion of graphics in messages. If the NTCIP 1203 v2 standard has not reached a “recommended” or “approved” state by the time of contract award, the manufacturer shall support graphics using manufacturer-specific objects and MULTI tags.

If a manufacturer-specific means of supporting graphics is used, the manufacturer shall commit to provide NTCIP 1203 v2 firmware updates at no cost to the cabinet. These updates shall include all current requirements of these specifications and standard graphics support. The updates shall be installed by the vendor no later than six months after the NTCIP 1203 v2 standard reaches the “approved” state.

VMS Intensity Control

The VMS controller shall provide means to change the brightness of the display matrix automatically. This automatic intensity control mode shall monitor the ambient light sensors or photo circuit of the VMS. The control shall have a minimum of 100 intensity levels, which can be communicated to the LED drivers in the VMS.

System Status Monitoring and Diagnostic Testing

The VMS controller shall be capable of monitoring the status of the VMS components and subsystems in real-time and/or manual modes, depending on the component or subsystem. The following sections detail the status and diagnostic information that shall be provided by the controller. The status and diagnostic data shall be available via the front panel LCD screen and shall be transmitted via NTCIP to control software upon request.

Message Display Status

The VMS controller shall be capable of monitoring and displaying the currently active message (if any) on the controller's front panel LCD display. This display shall be in a WYSIWYG format.

LED Pixel Testing

Upon command from either the front panel control interface or via NTCIP using remote software, the VMS controller shall direct all of the LED modules to perform diagnostic tests of all their pixels. The controller shall then collect and report the results of the pixel testing.

The VMS controller shall be capable of real-time, automatic detection of the on/off status of each of the display's pixels and reporting of such information as required. This monitoring shall take place without interfering with the display on the VMS face.

Power Supply Operation

The VMS controller shall be capable of full time monitoring and have the ability to report the voltage (to the nearest tenth of a volt) of each regulated DC power supplies located in the VMS by monitoring diagnostic outputs located on the supplies.

Door States

The VMS controller shall monitor and report the open/closed status of each of the VMS housing's doors (if equipped with door sensors). If a control equipment cabinet is present and is equipped with door sensors, the VMS controller shall also monitor the status of the control cabinet door(s).

Environmental Conditions

The VMS controller shall be capable of monitor and reporting the readings of constantly? All light, temperature, and humidity sensors installed in the VMS housing.

Error Notification

The VMS controller shall be capable of automatically informing a maintenance operator (via the local LCD panel) and a central control system (via NTCIP communication) of the occurrence of events and subsystem failures.

All component and subsystem errors shall be indicated on the controller's LCD front panel.

The VMS controller shall be capable of sending event notifications to the central control system via SNMP traps as allowed by NTCIP. When an event occurs, the VMS controller shall create a data packet for transmission to the central controller that contains details about the event. The transmission of traps shall be governed by the NTCIP standards. The controller shall be configurable to enable or disable the transmission of traps for each event or error type. This configuration shall include the automatic initiation of these traps, including establishing communications if appropriate, when the NTCIP network permits transmission initiation by the VMS controller.

Error Reporting

The following sections list errors and events that the controller shall report as defined above.

- Over Temperature Shutdown - The VMS controller shall continuously monitor the VMS housing's temperature sensors and shall automatically shut down the VMS if the internal cabinet temperature exceeds a safety threshold. This threshold shall have a default value of +140°F and shall be configurable at the controller. If the temperature exceeds that threshold, the controller shall trigger a warning notification event. This event shall completely turn off the LEDs.
- Controller Restart - When the VMS controller detects that it has been restarted due to a manual reset or error condition, it shall send a trap notification to the central system. It shall also automatically activate the NTCIP reset message if it is configured to do so.
- Power Loss - When the VMS controller detects that it has lost power, it shall automatically be indicated on the front panel LCD. If configured to do so, it shall send a trap notification to the central system and activate the NTCIP power loss message.
- Power System Failure - The VMS controller shall automatically monitor the power systems in the VMS and detect any failures. Any failures shall be reported on the front panel LCD and transmitted to the central system in the form of a trap.
- Door Opened - When the VMS controller detects that one of the VMS cabinet or control cabinet doors has been opened, it shall transmit a trap to the central system indicating which door has opened.
- Communication Loss - The VMS controller shall monitor the frequency of communication packets from the central system. If the controller detects that communication has not occurred between the controller and central system for longer than a user configured amount of time, the VMS controller shall automatically activate a communication loss message as defined by NTCIP. This communication loss message shall be configurable and may be disabled as allowed by NTCIP. A trap shall be sent to the central system.

Requirements for VMS Control Software

This section describes the minimum specifications for the VMS control software. The contractor shall provide all software, software media, licenses, and documentation necessary to install and operate a VMS control system that fully complies with the functional requirements herein, including incidental items required for operation that may have been inadvertently omitted.

General Specifications

VMS control software shall, at a minimum, comply with the following:

- Operate on desktop and laptop computers with Intel Pentium III or better processors and Microsoft Windows NT 4.0, 2000 Professional, or XP Professional operating systems

- Provide a user-friendly, multi-color, GUI
- Be written as a native 32-bit Windows program using Microsoft-certified software development tools (compilers, etc.)
- Be capable of controlling a network of at least 250 VMS
- Utilize a client-server architecture with the client connecting to the server via LAN or WAN and the server handling VMS communications
- Support VMS communications via any combination of dedicated hardwired serial network, fiber-optic network, dial-up telephone lines, leased phone lines, cellular telephone, CDPD, spread spectrum radio, Ethernet, or other
- Support VMS control, monitoring, and diagnostic functions
- Control VMS both remotely from a remote location and locally at the VMS site using a laptop computer
- Be accompanied by a software installation utility
- Furnish an operations manual that includes detailed instructions for configuring and using all parts of the software
- Contain an on-line help system that includes documentation for every screen or dialog box present in the software. The software shall also be context sensitive such that pressing the help button or [F1] key on any screen will launch the help page for that particular screen
- Be fully compliant with the communications protocol requirements of the NTCIP Special Provision

Software Security

VMS control software shall support the creation of user IDs and passwords for up to 100 system users. Only a System Administrator shall be permitted to create users and assign user access rights.

Before a system operator can use the VMS control software, the software shall request a username and password. If the correct username and password are not provided, access to the software shall be declined. The software shall lockout a user after failing to log in after a specified number of attempts.

Client-Server Architecture

The software shall be of a modular design including a server and multiple client modules. The server shall control all VMS communication and shall store all data and messages. The client software modules shall be capable of sending requests to and receive responses from the server over any TCP/IP-based network, including LANs and WANs. Separate clients shall be provided for each of the following software functions:

- Shell client that handles user login and logout and launching the other clients
- Display control client for controlling VMS messaging, monitoring system status, and performing VMS diagnostics
- Message editor client for creating and editing VMS messages
- Message scheduler client for creating time and date schedules for activating messages
- Administration client for VMS system configuration and administration

VMS Control

The VMS control software shall provide a user interface that presents the system's VMS status in both list and graphical formats. The software shall allow the VMSs to be grouped as needed by the administrator. The VMS list and map interfaces shall include only the VMSs for the group currently selected.

List and Map Interfaces

The VMS status list shall clearly display the following information about each VMS:

- VMS identification number, as "1" through "250"
- VMS name, in a descriptive text format
- Icon representation of the type of communication network used for the VMS (e.g. direct or dial-up)
- Name and priority level of message file being displayed
- Date and time of last communication between the control software and the VMS controller
- Error and warning status, including pixel errors, power failures, communication errors, etc.
- Configurable bitmaps that may be used to show all or parts of the system geographically
- Icons for each VMS that may be placed anywhere on the map
- Icon color changes to indicate the status of the VMS (i.e., yellow for warnings or red for errors)
- Icon flashes if a message is running on the VMS
- VMS name if mouse is placed over a VMS icon

Direct Control Operations

The user interface shall provide a means for users to directly perform the following tasks for each VMS:

- Send and activate stored messages from the libraries
- Blank the display
- Activate a quick message that is created immediately, not loaded from a library
- Send and activate schedules
- Retrieve both messages and schedules from the VMS
- Perform diagnostics of VMS subsystems such as power supplies, sensors, etc.
- Perform tests of pixels
- Monitoring of the VMS event log

Polling

The software shall have a feature to poll all or a set of VMS at predefined intervals or at a specific time-of-day. During a poll, the software shall retrieve the most recent status information from the VMS and present it to the user as appropriate in the list and map interfaces.

Scenarios

The administrator shall have the ability to create scenarios that act like macros or scripts to automate a series of often repeated tasks. These scenarios shall have the ability to perform

the following actions:

- Send and activate stored messages from the libraries
- Blank the display
- Send and activate schedules
- Perform diagnostics of VMS subsystems such as power supplies, sensors, etc.
- Perform tests of pixels

The scenarios shall be saved to libraries where system operators may activate them through the GUI. The scenarios shall also be capable of running automatically at scheduled times if programmed by the user.

System Monitoring

The software shall be capable of monitoring and displaying to the operator the contents of any communications in progress with VMS. The status of all outgoing and incoming data packets shall be displayed.

Multi-Vendor VMS Control

The software shall be capable of controlling any NTCIP-compatible VMS regardless of the manufacturer. The software shall support all mandatory and optional features typical in LED VMS. The software shall be configurable to enable or disable support for any standard optional NTCIP objects.

Message Creation and Editing

A VMS system operator shall be able to use the VMS control software to create, edit, name, and store message files.

Message Editor Defaults

The message editor shall automatically utilize the following default settings during the creation of new message files:

- Pixel spacing between adjacent lines of text
- Pixel spacing between adjacent text characters
- Display duration of a given message page
- Color palette to be used for color-capable VMSs
- Beacon activation status (for VMS that contain flashing beacons)
- Effect to be applied to text (e.g., static, scrolling, etc.)
- Effect rate, which shall determine the speed of scrolling messages
- Flash rate, which shall determine the speed of flashing messages
- Message priority classification
- Horizontal text justification supporting left, center, or right
- Vertical text justification supporting top, middle, and bottom

Message Priorities

User-definable default settings shall allow messages to be assigned a priority classification of:

- Emergency
- High

- Normal
- Low
- Minimal

A numeric priority range shall be assigned to each of these five priority classifications. The priority shall allow two different message files to be assigned the same classification. Within that classification, one message can be identified as having higher priority.

The message editor GUI shall present a scaled image of the VMS display matrix, including a complete and accurate representation of the display matrix type (full or line) and the number of display pixels. The VMS editor image shall actively show message content in a WYSIWYG format, while a new message is being created or an existing message is being edited.

The message editor shall provide the operator with the ability to program:

- The number of pages (one to six) that the message is to contain
- Message text
- Message graphics, including pixel-by-pixel editing, lines, area fill, block move, etc.
- Character font type(s) used to construct the message
- The amount of inter-line spacing, measured in pixels
- Horizontal message justification on the VMS display matrix including left, center, and right
- Vertical message justification on the VMS display matrix including top, middle, and bottom
- The type of entry effect (static or scrolling)
- Message page on time and off time
- Message scroll rate, if applicable
- The flash rate of all or part of a message page, if applicable
- Message priority status
- The display status of any flashing beacons mounted to the VMS

The message editor shall provide a method of incorporating data fields into a VMS message.

The following data fields shall be provided:

- Time, in 12 hour format
- Time, in 24 hour format
- Temperature, in °F and °C
- Vehicle speed, in kph and mph (for VMS sites that contain speed measurement equipment)
- Day of week
- Day of the month
- Month of the year
- Calendar year, in both two-digit and four-digit formats

The message editor shall provide a convenient means for the operator to:

- Insert, add or delete message text

- Paste graphics from other programs using the Windows clipboard
- Clear the contents of the editing page
- Save the message file under its existing name or a new name
- Delete a message file
- Save all changes

It shall be possible to store message files in both the VMS control computer memory and the VMS controller memory.

The system operator shall have the ability to print any message or library of messages.

Message Libraries

VMS control software shall support the creation, editing and storage of message libraries (file directories), which allow the system operator to categorize message files by:

- VMS matrix size
- Message subject matter

The library editor shall allow a system operator to:

- Create a new library
- Store the same message in multiple libraries
- Select a message from an existing library and edit the message contents
- Search libraries for messages with specified text in message name or contents
- Copy/Paste a message from one library to another
- Delete a message file from a library
- Rename a library
- Delete a library
- Save all changes

Schedule Creation and Editing

VMS control software shall support the creation, editing and storage of message schedules, which instruct the VMS controller to run specific messages at pre-determined times and dates.

Software shall contain an editor, which allows messages to be scheduled via:

- Month of the year
- Day of the week
- Day of the month
- Time of day

The schedule editor shall provide a means for the operator to:

- Create a new schedule
- Rename an existing schedule
- Delete a schedule
- Save all change

It shall be possible to store schedule files in both the VMS control computer memory and the VMS controller memory.

Display Fonts

The software shall support a minimum of 12 fonts for each model of VMS. These fonts shall be configurable by the system administrator. The fonts used shall be selectable from a library containing a minimum of 24 fonts provided by the software vendor. Each VMS model shall be capable of using a different set of fonts. The software shall automatically adjust the available fonts in the message editor based on the VMS model configuration.

The software shall include a font editor to allow the operator to create custom fonts. The font editor shall allow the administrator to create new fonts or modify existing fonts. The operator shall have the capabilities to graphically edit each character within a font in a pixel-by-pixel manner.

All fonts provided by the software vendor or created/modified by the administrator shall be downloadable to the VMS.

Event Logging

The software shall include an event logging system that logs all system events. Each logged event shall, at a minimum, include the following:

- Event ID number
- Operator who initiated the event
- Time and date that the event occurred
- Description of the event (e.g., “Diagnostic Test Performed”)
- Source of the event (e.g., VMS name)
- Additional data relevant to the event (e.g., “Failed pixel: (4, 73)”)

The events logged shall include, but not be limited to, the following:

- User login/logout
- Failed login attempts
- Communication failures
- Message and schedule activation or display blanking
- Diagnostics test results
- Warning events sent from the VMS
- Other system errors

The system operator shall have the ability to view, sort by category, and print the log file at any time.

System Configuration

The VMS control software shall allow users with security access rights to configure system parameters and functions. The basic sets of configurable settings include the following:

- VMS models and individual signs
- Communication networks
- System error/warning alarms
- User security rights
- System maps and VMS icon placement

- Default system options settings
- Default message parameters
- Message priority settings

VMS Configuration

At a minimum, the following information for each VMS shall be configurable in the VMS control software:

- VMS viewing area height and width (for full-matrix VMS)
- Number of lines and each line's height and width (for line-matrix VMS)
- Color capabilities (e.g., amber, tricolor, full-color, etc.)
- Site name
- VMS identification number
- Network address
- Communication parameters

Communication Settings

Communication network control shall include the ability to configure and modify VMS communication networks with the following parameters:

- Network type (e.g., direct serial, dial-up)
- Communication port (e.g. COM4)
- Baud rate (ranging from 1200 to 115,200)
- Hardware handshaking
- NTCIP subnetwork and transport protocols
- Communication retries and timeouts

System Alarms

Configurable settings shall allow the system administrator to determine which of the following events will trigger an audio and/or visual (on-screen) alarm:

- Communication failure
- Priority status conflict
- VMS restart
- Power supply failure
- Door open

User Administration

The administrator shall have the ability to add, remove and modify users and user's access rights? The access rights of each user shall be configurable to allow or deny access to any software feature.

System Maps

It shall be possible to configure each VMS group to appear on a map within the software. The administrator shall be able to use the software to select a map, identified as a bitmap file, which can then be imported into the software. Each VMS shall have an icon that may be placed anywhere on the map.

Software Use and Reproduction Rights

The VMS manufacturer shall provide a VMS control software site license with the VMS supplied for this contract. Ten copies of the VMS control software shall be provided to the engineer on CD-ROM within 30 days of contract award. The Cabinet shall have the right to request or reproduce an unlimited number of software copies for use on the VMS system installed for this contract.

Requirements for NTCIP Conformance

This section describes the minimum specifications for the NTCIP communication capabilities of the VMS controller and VMS control software. The contractor shall provide all software, firmware, and services necessary to operate a VMS system that fully complies with the NTCIP functional requirements, including incidental items required for operation that may have been inadvertently omitted.

References

These specifications reference standards through their NTCIP designated names. Table 3 lists the current version of each of these standards.

Each NTCIP device covered by these project specifications shall implement the version of the applicable standard listed in Table 3. Refer to the NTCIP library at <http://www.ntcip.org> for information on the current status of NTCIP standards.

Table 3: NTCIP Document References

Document Number	Document Title	Document Status
NTCIP 1101:1996 and Amendment 1	<i>Simple Transportation Management Framework (STMF)</i>	Jointly Approved
NTCIP 1102 v1.12	<i>Octet Encoding Rules (OER) Base Protocol</i>	Recommended Standard
NTCIP 1103 v1.15	<i>Transportation Management Protocols</i>	User Comment Draft
NTCIP 1201:1996 and Amendment 1	<i>Global Object Definitions</i>	Jointly Approved
NTCIP 1203:1997 and Amendment 1	<i>Object Definitions for Dynamic Message Signs</i>	Jointly Approved
NTCIP 2001:1996 and Amendment 1	<i>Class B Profile</i>	Jointly Approved
NTCIP 2101:2001	<i>Point to Multi Point Protocol (PMPP) Using RS-232 Subnetwork Profile</i>	Jointly Approved
NTCIP 2103 v1.13	<i>Point-to-Point Protocol Over RS-232 Subnetwork Profile</i>	Jointly Approved
NTCIP 2104 v1.10	<i>Ethernet Subnetwork Profile</i>	Jointly Approved
NTCIP 2201 v1.14	<i>Transportation Transport Profile</i>	Jointly Approved
NTCIP 2202:2001	<i>Internet (TCP/IP and UDP/IP) Transport Profile</i>	Jointly Approved
NTCIP 2301:2001	<i>Simple Transportation Management Framework</i>	Jointly Approved

Document Number	Document Title	Document Status
	<i>(STMF) Application Profile</i>	

Subnetwork Profiles

Each serial or modem port on each NTCIP device shall be configurable to support both NTCIP 2101 and NTCIP 2103. Only one of these profiles shall be active at any given time. Serial ports shall also support external dial-up modems.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2104.

The NTCIP devices may support additional subnet profiles at the manufacturer’s option. At any one time, only one subnet profile shall be active on a given port of the NTCIP device. All response datagram packets shall use the same transport profile used in the request. The NTCIP device shall be configurable to allow a field technician to activate the desired subnet profile and shall provide a visual indication of the currently selected subnet profile.

Transport Profiles

Each serial or modem port on each NTCIP device shall be configurable to support both NTCIP 2201 and NTCIP 2202.

Each Ethernet port on the NTCIP device shall comply with NTCIP 2202.

The NTCIP devices may support additional transport profiles at the manufacturer’s option. Each NTCIP device shall support the receipt of datagram’s conforming to any of the supported transport profiles at any time. Response datagram packets shall use the same transport profile used in the request.

Application Profiles

Each NTCIP device shall comply with NTCIP 2301 and shall meet the requirements for Conformance Level 1.

An NTCIP device may support additional application profiles at the manufacturer’s option. Responses shall use the same application profile used by the request. Each NTCIP device shall support the receipt of application data packets at any time allowed by the subject standards.

Object Support

Each NTCIP device shall support all mandatory objects of all mandatory conformance groups as defined in NTCIP 1201 and NTCIP 1203.

Each NTCIP device shall support all mandatory objects in all optional conformance groups. All optional objects listed shall be supported.

The NTCIP devices shall support the optional conformance groups listed in Table 4.

Table 4: Optional Conformance Groups

Conformance Group	Reference
Time Management	NTCIP 1201
Timebase Event Schedule	NTCIP 1201
Report	NTCIP 1201
PMPP	NTCIP 1201
Font Configuration	NTCIP 1203
VMS Configuration	NTCIP 1203
MULTI Configuration	NTCIP 1203
MULTI Error Configuration	NTCIP 1203
Illumination/Brightness Control	NTCIP 1203
Scheduling	NTCIP 1203
VMS Status	NTCIP 1203
Status Error	NTCIP 1203
Pixel Error Status	NTCIP 1203

Table 5 lists objects that are considered optional in the NTCIP standards, but are required by this specification. Table 5 also indicates modified object value ranges for certain objects. Each NTCIP device shall provide the FSORS of all objects required by these specifications unless otherwise indicated in Table 5.

Table 5: Modified Object Ranges and Required Optional Objects

Object	Reference	Project Requirement
moduleTable	NTCIP 1201 Clause 2.2.3	Shall contain a minimum of one row with moduleType = 3 (software).
maxTimeBaseScheduleEntries	NTCIP 1201 Clause 2.4.3.1	Shall be a minimum of 28
maxDayPlans	NTCIP 1201 Clause 2.4.4.1	Shall be a minimum of 20
maxDayPlanEvents	NTCIP 1201 Clause 2.4.4.2	Shall be a minimum of 12
maxEventLogConfig	NTCIP 1201 Clause 2.5.1	Shall be a minimum of 50
eventConfigMode	NTCIP 1201 Clause 2.4.3.1	NTCIP Component shall support the onChange, greaterThanValue, and smallerThanValue event configurations
eventConfigLogOID	NTCIP 1201 Clause 2.5.2.7	FSORS
eventConfigAction	NTCIP 1201 Clause 2.5.2.8	FSORS
maxEventLogSize	NTCIP 1201 Clause 2.5.3	Shall be a minimum of 200
maxEventClasses	NTCIP 1201 Clause 2.5.5	Shall be a minimum of 16
eventClassDescription	NTCIP 1201 Clause 2.5.6.4	FSORS
maxGroupAddresses	NTCIP 1201 Clause 2.7.1	Shall be a minimum of 1
communityNamesMax	NTCIP 1201 Clause 2.8.2	Shall be a minimum of 3
NumFonts	NTCIP 1203 Clause 2.4.1.1.1.1	Shall be a minimum of 8
MaxFontCharacters	NTCIP 1203 Clause 2.4.1.1.3	Shall be a minimum of 255
defaultFlashOn	NTCIP 1203 Clause 2.5.1.1.3	VMS shall support the full range of

Object	Reference	Project Requirement
		these objects with step sizes between 0.1 and 0.5 seconds
defaultFlashOff	NTCIP 1203 Clause 2.5.1.1.1.4	VMS shall support the full range of these objects with step sizes between 0.1 and 0.5 seconds
defaultBackgroundColor	NTCIP 1203 Clause 2.5.1.1.1.1	VMS shall support the black background color
defaultForegroundColor	NTCIP 1203 Clause 2.5.1.1.2	VMS shall support the amber foreground color
defaultJustificationLine	NTCIP 1203 Clause 2.5.1.1.1.6	VMS shall support left, center, and right line justification
defaultJustificationPage	NTCIP 1203 Clause 2.5.1.1.1.7	VMS shall support top, middle, and bottom page justification
defaultPageOnTime	NTCIP 1203 Clause 2.5.1.1.1.8	VMS shall support the full range of this object with step sizes no larger than 0.5 seconds
defaultPageOffTime	NTCIP 1203 Clause 2.5.1.1.1.9	VMS shall support the full range of this object with step sizes no larger than 0.5 seconds
defaultCharacterSet	NTCIP 1203 Clause 2.5.1.1.1.10	VMS shall support the eight bit character set
dmsMaxChangeableMsg	NTCIP 1203 Clause 2.6.1.1.1.4	Shall be a minimum of 100
dmsMessageMultiString	NTCIP 1203 Clause 2.6.1.1.1.8.3	VMS shall support any valid MULTI string containing any subset of the MULTI tags listed in Table 6
dmsControlMode	NTCIP 1203 Clause 2.7.1.1.1.1	Shall support, at a minimum, the following modes: local, central, and centralOverride
dmsSWReset	NTCIP 1203 Clause 2.7.1.1.1.2	FSORS
dmsMessageTimeRemaining	NTCIP 1203 Clause 2.7.1.1.1.4	FSORS
dmsShortPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.8	FSORS
dmsLongPowerRecoveryMessage	NTCIP 1203 Clause 2.7.1.1.1.19	FSORS
dmsShortPowerLossTime	NTCIP 1203 Clause 2.7.1.1.1.10	FSORS
dmsResetMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsCommunicationsLossMessage	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsTimeCommLoss	NTCIP 1203 Clause 2.7.1.1.1.12	FSORS
dmsEndDurationMessage	NTCIP 1203 Clause 2.7.1.1.1.15	FSORS
dmsMemoryMgmt	NTCIP 1203 Clause 2.7.1.1.1.16	VMS shall support the normal and clearChangeableMessages memory management modes
dmsMultiOtherErrorDescription	NTCIP 1203 Clause 2.4.1.1.1.20	If the vendor implements any vendor-specific MULTI tags, the VMS shall provide meaningful error messages within this object whenever one of these tags generates an error
dmsIllumControl	NTCIP 1203 Clause 2.8.1.1.1.1	VMS shall support photocell and

Object	Reference	Project Requirement
		manual illumination control modes
dmsIllumNumBrightLevels	NTCIP 1203 Clause 2.8.1.1.1.4	Shall be a minimum of 255
dmsIllumLightOutputStatus	NTCIP 1203 Clause 2.8.1.1.1.9	FSORS
numActionTableEntries	NTCIP 1203 Clause 2.9.1.1.1	Shall be a minimum of 200
watcdogFailureCount	NTCIP 1203 Clause 2.11.1.1.1.5	FSORS
dmsStatDoorOpen	NTCIP 1203 Clause 2.11.1.1.1.6	FSORS
fanFailures	NTCIP 1203 Clause 2.11.2.1.1.8	FSORS
fanTestActivation	NTCIP 1203 Clause 2.11.2.1.1.9	FSORS
tempMinCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.1	FSORS
tempMaxCtrlCabinet	NTCIP 1203 Clause 2.11.4.1.1.2	FSORS
tempMinSignHousing	NTCIP 1203 Clause 2.11.4.1.1.5	FSORS
tempMaxSignHousing	NTCIP 1203 Clause 2.11.4.1.1.6	FSORS

MULTI Tags

Each NTCIP device shall support the message formatting MULTI tags in Table 6. The manufacturer may choose to support additional standard or manufacturer-specific MULTI tags.

Table 6: Required MULTI Tags

MULTI Tag	Description
F1	Field 1 time (12 hr)
F2	Field 1 time (24 hr)
F8	Field 8 day of month
F9	Field 9 month
F10	Field 10 2 digit year
F11	Field 11 4 digit year
F1 (and /fl)	Flashing text on a line-by-line basis with flash rates controllable in 0.1 second increments.
Fo	Font
Jl2	Line Justification - Left
Jl3	Line Justification - Center
Jl4	Line Justification - Right
JP2	Page Justification - Top
JP3	Page Justification - Middle
JP4	Page Justification - Bottom
Mv	Moving text
Nl	New line
np	New page up to at least 5 instances in a message (i.e. up to at least 1 to 6 pages/frame in a message counting first page)
Pt	Page times controllable in 0.1-second increments

DOCUMENTATION

NTCIP documentation shall be provided on CD-ROM and contain ASCII versions of the following MIB files in ASN.1 format:

- The version of each official standard MIB module referenced by the device.
- If the device does not support the full range of any given object within a standard MIB module, a manufacturer-specific version of the official standard MIB module with the supported range indicated in ASN.1 format in the SYNTAX and/or DESCRIPTION fields of the associated OBJECT TYPE macro. The filename of this file shall be identical to the standard MIB Module except that it shall have the extension “man”.
- An MIB module in ASN.1 format containing any and all manufacturer specific objects supported by the device with accurate and meaningful DESCRIPTION fields and supported ranges indicated in the SYNTAX field of the OBJECT-TYPE macros.
- An MIB containing any other objects supported by the device

ACCEPTANCE TESTING

The manufacturer shall provide certification of NTCIP-compliance as part of the pre-build submittal documentation. This certification shall be in the form of a comprehensive test plan and completed test report as performed by either the ITS integrator or a third-party testing agency. The testing shall have been completed using industry accepted test tools such as the NTCIP Exerciser, Trevilon’s NTester, Intelligent Devices’ Device Tester, and/or Frontline’s FTS for NTCIP. Data capture files from the FTS software during the performance of the above testing shall be furnished upon request of the Engineer.

The Engineer may perform additional NTCIP testing if desired. This testing shall be conducted on a production VMS in the manufacturer’s facility during the factory acceptance test. The manufacturer shall provide a written NTCIP test procedure to the Engineer a minimum of 30 days prior to the NTCIP testing.

This item includes conduit and wiring on supporting structure. This item includes all costs for the manufacturer field engineer to perform on-site testing and setup. This item includes all costs for engineering analysis required in the VMS specifications.

INTERPRETATION RESOLUTION

If the Engineer or VMS manufacturer discovers an ambiguous statement in the standards referenced by this procurement specification, the issue shall be submitted to the NTCIP VMS Working Group for resolution. If the Working Group fails to respond within 90 days, the Engineer shall provide an interpretation of the specification for use on the project.

WARRANTY

The manufacturer shall supply at least a five year warranty of all components involved with the operations of the VMS sign. This shall include any tech support, replacement parts and shipping of replacement parts. All warranties shall be transferable and shall start when the VMS Sign is commissioned on site by the manufacturer.

INSTALLATION

VMS shall be installed in accordance with the sign and sign post manufacturers' specifications. The Contractor shall coordinate with the sign and sign post manufacturers to resolve mechanical compatibility problems prior to fabrication of either item.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Variable Message Sign will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

WIRE AND CABLE

DESCRIPTION

Furnish and install Wire and Cable in accordance with the plans, specifications and Standard Drawings.

MATERIALS

Unless otherwise specified, wire shall be stranded copper type USE. This item shall include all connectors, splicing and insulating hardware, ties, tape, labels and incidentals required for electrical connections. The Contractor shall submit to material testing at the discretion of the Engineer.

INSTALLATION

The Contractor shall install all cable or wire runs splice-free from the controller/service location to each cabinet, VMS sign, or CCTV camera the cable or wire is feeding. All wire shall be labeled inside cabinets and junction boxes. The contractor shall not use excessive force when pulling wire through duct. The contractor shall replace all wire damaged during installation. The Engineer may require testing of wiring for damaged insulation. Wire that does not pass an insulation resistance test of a minimum of 100 hundred megohms to ground shall be replaced by the Contractor at his cost.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Wire and cable will be measured for payment per unit linear foot. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section.

VIDEO MONITOR

DESCRIPTION

Furnish and install Video Monitor in accordance with the plans, specifications and Standard Drawings.

MATERIALS

VIDEO MONITOR

The video display unit shall be Samsung 460PN or approved equal. The video display unit shall meet the following requirements:

- Panel Type: a-si TFT/MVA
- Size: 46"
- Maximum Resolution: 1366 x 768
- Pixel Pitch: 0.249mm (H)
- Brightness: 500 cd/m²
- Contrast Ratio: 800:1
- Viewing Angle: 170/170 (degrees)
- Interface: Analog/Digital
- Aspect Ratio: 16:9
- Input Video Signal: Analog RGB, BNC, DVI-D, CVBS Video, S-Video, Component Video
- Video Level Analog: 0-7V P-P, Digital TDMSTM
- Sync Type: Separate H/V, Composite H/V, SOG
- Input Connectors: D-Sub, DVI-D, S-Video, BNC(Video), BNC (component 2), RS232C cable
- Bezel Color: Black
- Nominal Dimensions: 49" Wide x12" High x32" Deep
- Nominal Gross Weight: 77 lbs
- Special Features: S-Video, PIP, PBP, RS232C, Supports NTSC/PAL/SECAM, Wall Mounting & Pivot, MagicNet (Network Capability)

This item shall include power supplies necessary to connect these item in the District 2 War room.

INSTALLATION

Installation shall be in accordance with the Kentucky Standard Specifications for Road and Bridge Construction, 2004 edition, the NEC and NESC. The installation of these items shall be the responsibility of the contractor.

METHOD OF MEASUREMENT AND BASIS OF PAYMENT

Video Monitor will be measured for payment per unit each. The Department will make payment for complete, functioning, inspected, and accepted quantities. The Department will consider payment as full compensation for all work required under this section

GLOSSARY

The following acronyms, abbreviations, and definitions shall govern this specification:

- AASHTO – American Association of State Highway and Transportation Officials
- ABS - Acrylonitrile Butadiene Styrene
- AC – Alternating Current
- AlInGaP – Aluminum Indium Gallium Phosphide (refers to the chemical composition of an LED).
- ANSI – American National Standards Institute
- ASCII – American Standard Code for Information Interchange
- ASN.1 – Abstract Syntax Notation 1
- ASTM – American Society for Testing and Materials
- AWG - American Wire Gauge
- AWS – American Welding Society
- BCD – Binary Coded Decimal
- B frames – Bi-directional Predicted Frames
- BGP – Border Gateway Protocol
- Bin – Group of LEDs categorized and sorted by intensity or color. Each bin has upper and lower intensity or color specifications and contains only LEDs that are measured to be within that range. LED manufacturers sort LEDs into bins to ensure consistent intensity and color properties.
- BOOTP – Bootstrap Protocol
- CALTRANS – California Department of Transportation
- CAN – Control Area Network
- CCTV – Closed Circuit Television
- CDPD – Cellular Digital Packet Data
- CLI – Command Line Interface
- CNC – Computer Network Control
- Control Computer – A desktop or laptop computer used in conjunction with VMS control software to communicate with VMS sign controllers. The control computer can instruct a VMS sign controller to program and control the VMS, monitor VMS status, and run VMS diagnostic tests. A control computer can be used for remote control of one of more VMS, as well as for local control of a single VMS
- DC – Direct Current
- DHCP – Dynamic Host Configuration Protocol
- DMS – Dynamic Message Sign. An industry term that applies to various types of changeable sign technology
- DVI-D – Digital Visual Interface - Digital
- EIA – Electronic Industries Association
- ELFEXT – Equal Level Far End Crosstalk
- EPA – Effective Projected Area
- FCC – Federal Communications Commission

- FDA – Food and Drug Administration
- Font – The style and shape of alphanumeric characters that are displayed on the VMS matrix to create messages viewed by motorists and travelers
- Frame – see *Page*
- FSORS – Full, Standardized Object Range Support – an NTCIP term. See the NTCIP standards for additional information.
- GUI – Graphical User Interface
- HDPE – High Density Polyethylene
- HHR – Half Horizontal Resolution
- HTTP – Hypertext Transfer Protocol
- IEEE – Institute of Electrical and Electronic Engineers
- I frames – Intra-frames
- IC – Integrated Circuit
- IGMP
- InGaAlP – Indium Gallium Aluminum Phosphide
- I/O – Input/Output
- IP – Internet Protocol – in transceivers
- IRE – Institute of Radio Engineers
- ISO – International Organization for Standardization
- ITE – Institute of Transportation Engineers
- ITS – Intelligent Transportation System
- Kbps – Kilobits per second
- KYTC – Kentucky Transportation Cabinet
- LAN – Local Area Network
- LCD – Liquid Crystal Display
- LED – Light Emitting Diode
- MDPE – Medium Density Polyethylene
- Message – Information displayed on the VMS for the purpose of visually communicating with motorists. A VMS message can consist of one or more pages of data that are displayed consecutively
- MIB – Management Information Base
- Module – Assembly consisting of a two-dimensional LED pixel array, pixel drive circuitry, and mounting hardware. Modules are installed in the display adjacent to each other to form the display matrix.
- MTBF – Mean Time Between Failures
- MPEG – Moving Picture Experts Group
- NEC – National Electrical Code
- NEMA – National Electrical Manufacturers Association
- NESC – National Electrical Safety Code
- NEXT – Near End Crosstalk
- NCHRP – National Cooperative Highway Research Program
- NRZ – Non Return to Zero
- NRZI – Non Return to Zero Inverted

- NTCIP – National Transportation Communications for ITS Protocol
- NTSC - National Transmission Standards Committee
- Object – An NTCIP term referring to an element of data in an NTCIP-compatible device that can be manipulated to control or monitor the device.
- OER – Octet Encoding Rules
- OSHA – Occupational Safety and Health Administration
- OTDR – Optical Time Domain Reflectometer
- Page – An NTCIP term referring to the data that is displayed on the VMS display matrix at a given moment in time. Also referred to as a frame.
- P frames – Forward Predicted Frames
- PCB – Printed Circuit Board
- Pixel – Picture element. The smallest changeable (programmable) portion of a VMS display matrix
- PMPP – Point to Multi-Point Protocol
- PPP – Point to Point Protocol
- PSELFEXT – Power Sum Equal Level Far End Cross Talk
- PSNEXT – Power Sum Near End Crosstalk
- PTZ – Pan/Tilt/Zoom
- PVC – Polyvinyl Chloride
- PWM – Pulse Width Modulation
- QSIF – Quarter Source Input Format
- RAM – Random Access Memory
- RARP – Reverse Address Resolution Protocol
- RGB – Red-Green-Blue
- Schedule – A set of data that determines the time and date when a VMS sign controller will cause a stored message to be displayed on the VMS
- SDRAM – Synchronous Dynamic Random Access Memory
- SIF – Source Input Format
- SNMP – Simple Network Management Protocol
- STMP – Simple Transportation Management Framework
- Stroke – Refers to the vertical and horizontal width of the lines and curves of a display font. Single stroke denotes character segments that are one pixel wide. Double stroke denotes character segments that are two pixels wide.
- TFTP – Trivial File Transfer Protocol
- TIA - Telecommunications Industry Association
- TMA – Truck Mounted Attenuator
- TOC – Traffic Operations Center
- UL – Underwriters Laboratories
- UPS – Uninterruptible Power Supply
- USB – Universal Serial Bus
- VLAN – Virtual Local Area Network
- VMS – Variable Message Sign. A type of VMS that is fully programmable such that the content of its messages are fully changeable remotely and electronically.

- VMS Controller – A stand-alone computer that is located at a VMS site, which controls a single VMS. A sign controller receives commands from and sends information to a control computer
- WAN – Wide Area Network
- WYSIWYG – What You See Is What You Get. More specifically, what you see on the VMS control computer monitor is a scaled representation of how a message will appear when it is being displayed on the VMS. Similarly, after a pixel diagnostic test routine has been run, what you see on the control computer monitor is a scaled representation of the functional status of each pixel in the VMS display matrix.

Right-of-Way Certification Form

Federal Funded

State Funded

This form must be completed and submitted to FHWA with the PS&E package for federal-aid funded Interstate, Appalachia, and Mega projects. This form shall also be submitted to FHWA for **all** federal-aid projects that fall under conditions No. 2 & 3 outlined elsewhere in this form. For all other federal-aid projects, this form shall be completed and retained in the KYTC project file.

Date: August 1, 2008

Project #: _____

County: CHRISTIAN

Item #: 2-192.00

Federal #: DPR 0171 (004)

Letting Date: September 26, 2008

Projects that require **NO** new or additional right-of-way acquisitions and/or relocations

The proposed transportation improvement will be built within the existing rights-of-way and there are no properties to be acquired, individuals and families ("relocatees") to be relocated, or improvements to be removed as a part of this project.

Projects that require new or additional right-of-way acquisitions and/or relocations

Per 23 CFR 635.309, the KYTC hereby certify that all relocatees have been relocated to decent, safe, and sanitary housing or that KYTC has made available to relocatees adequate replacement housing in accordance with the provisions of the current FHWA directive(s) covering the administration of the Highway Relocation Assistance Program **and** that at least one of the following three conditions has been met. **(Check those that apply.)**

1. All necessary rights-of-way, including control of access rights when applicable, have been acquired including legal and physical possession. Trial or appeal of cases may be pending in court but legal possession has been obtained. There may be some improvements remaining on the right-of-way, but all occupants have vacated the lands and improvements, and KYTC has physical possession and the rights to remove, salvage, or demolish these improvements and enter on all land. **Fair market value has been paid or deposited with the court.**

2. Although all necessary rights-of-way have not been fully acquired, the right to occupy and to use all rights-of-way required for the proper execution of the project has been acquired. Trial or appeal of some parcels may be pending in court and on other parcels full legal possession has not been obtained, but right of entry has been obtained, the occupants of all lands and improvements have vacated, and KYTC has physical possession and right to remove, salvage, or demolish these improvements. **Fair market value has been paid or deposited with the court for most parcels. Fair market value for all pending parcels will be paid or deposited with the court prior to start of construction. (See note.)**

Note: The KYTC shall re-submit a right-of-way certification form for this project prior to the start of construction, verifying that fair market value for all parcels has been paid or deposited with the court.

Right-of-Way Certification Form

3. The acquisition or right of occupancy and use of a **few** remaining parcels are not complete and/or some parcels still have occupants. However, all remaining occupants have had replacement housing made available to them in accordance with 49 CFR 24.204. The KYTC is hereby requesting authorization to advertise this project for bids and to proceed with physical construction even though the necessary rights-of-way will not be fully acquired, and/or some occupants will not be relocated, and/or the fair market value will not be paid or deposited with the court for some parcels at the start of construction. KYTC will fully meet all the requirements outlined in 23 CFR 309(c) (3) and 49 CFR 102(j) and will expedite completion of all acquisitions, relocations, and full payments after construction starts. A full explanation and reason for this request, including identification of each such parcel and dates on which acquisitions, payments, and relocations will be completed, is attached to this certification form for FHWA consideration of approval. **(See note.)**

Note: The KYTC may request authorization on this basis only in unique and unusual circumstances. Proceeding to construction of projects on this basis shall be the exception and never become the rule. In all FHWA-approved cases, the KYTC shall make extraordinary efforts to expedite completion of the acquisition, payment for all affected parcels, and the relocation of all relocatees promptly after start of construction.

Approved: Everett T. Green August 1, 2008 _____ District ROW Supervisor
Printed Name Approved

Approved: DAVID L. ORR 9-30-08 Director of ROW & Utilities or Designee
Printed Name Approved

Approved: N/A _____ FHWA, Right-of-Way Officer
Printed Name Approved 

Right-of-Way Certification Form

Date: _____

Project #: _____

County: _____

Item #: _____

Federal #: _____

Letting Date: _____

This project has _____ total number of parcels to be acquired, and _____ total number of individual or families to be relocated, as well as _____ total number of businesses to be relocated.

- _____ Parcels where acquired by a signed fee simple deed and fair market value has been paid
- _____ Parcels have been acquired by IOJ through condemnation and fair market value has been deposited with the court
- _____ Parcels have not been acquired at this time (*explain below for each parcel*)
- _____ Parcels have been acquired or have a "right of entry" but fair market value has not been paid or has not been deposited with the court (*explain below for each parcel*)
- _____ Relocatees have not been relocated from parcels: _____ and _____ (*explain below for each parcel*)

Parcel #	Name/Station	Explanation for delayed acquisition, delayed relocation, or delayed payment of fair market value	Proposed date of payment or of relocation

There are _____ billboards and/or _____ cemeteries involved on this project.
There are _____ water or monitoring wells on parcels _____ and _____. All have been acquired and are the responsibility of the project contractor to close/cap.

**UTILITY NOTES TO BE INCLUDED IN THE PROPOSAL
SPECIAL NOTES FOR UTILITY CLEARANCE
IMPACT ON CONSTRUCTION**

**Christian County
Fort Campbell Variable Message Board
Item No. 2-192.00**

The following is a list of utility companies involved on this project. Contractor is advised to use caution and call **BUD** prior to beginning work.

There are no known utilities that will be impacted by this project.

PROTECTION OF UTILITIES

The location of utilities provided in the contract documents has been furnished by the facility owners and/or by reviewing record drawings and may not be accurate. It will be the roadway contractor's responsibility to locate utilities before excavating by calling the various utility owners and by examining any supplemental information supplied by the cabinet. If necessary, the roadway contractor shall determine the exact location and elevation of utilities by hand digging to expose utilities before excavating in the area of a utility. The cost of repair and any other associated costs for any damage to utilities caused by the roadway contractor's operations shall be borne by the roadway contractor.

The contractor is advised to contact the **BUD one-call system at 1-800-752-6007** at least two working days prior to excavating. Contractor should be aware that owners of underground facilities are not required to be members of the BUD one-call system. It may be necessary for the contractor to contact the County Court Clerk to determine what utility companies have facilities in the project area.

PART II

SPECIFICATIONS AND STANDARD DRAWINGS

SPECIFICATIONS REFERENCE

Any reference in the plans or proposal to the *Standard Specifications for Road and Bridge Construction, Edition of 2004*, and *Standard Drawings, Edition of 2000* are superseded by *Standard Specifications for Road and Bridge Construction, Edition of 2008* and *Standard Drawings, Edition of 2003*.

Special Notes [SN] and Special Provisions [SP] marked with an asterisk * and listed under Part II of the Table of Contents within this proposal can be referenced in the *Standard Specifications for Road and Bridge Construction, Edition of 2008*. Special Notes and Special Provisions not marked with an asterisk will be attached to this proposal.

**Supplemental Specifications to The Standard Specifications
for Road and Bridge Construction, 2008 Edition**
(Effective with the October 31, 2008 Letting)

SUBSECTION: 102.07.01 General. REVISION: Replace the first sentence with the following: Submit the Bid Proposal on forms furnished on the Department internet website (http://transportation.ky.gov/contract/), including the Bid Packet and disk created from the Expedite Bidding Program.
SUBSECTION: 102.07.02 Computer Bidding. REVISION: Replace the first paragraph with the following: Subsequent to ordering a Bid Proposal for a specific project, use the Department's Expedite Bidding Program on the internet website of the Department of Highways, Division of Construction Procurement (http://transportation.ky.gov/contract/). Download the bid file from the Department's website to prepare a Bid Proposal for submission to the Department. Include the completed Bid Packet produced by the Expedite Bidding Program in the Bid Proposal and submit it along with the disk created by said program. Replace the second paragraph with the following: In case of a dispute, the printed Bid Proposal and bid item sheets created by the Expedite Bidding Program take precedence over any bid submittal.
SUBSECTION: 102.08 IRREGULAR BID PROPOSALS. REVISION: Replace point four of the first paragraph with the following: 4) fails to submit a disk created from the Expedite Bidding Program. Replace point one of the second paragraph with the following: 1) when the Bid Proposal is on a form other than that furnished by the Department or printed from other than the Expedite Bidding Program, or when the form is altered or any part is detached; or
SUBSECTION: 103.02 AWARD OF CONTRACT. REVISION: Replace the first sentence of the third paragraph with the following: The Department will normally award the Contract within 10 working days after the date of receiving Bid Proposals unless the Department deems it best to hold the Bid Proposals of any or all bidders for a period not to exceed 60 calendar days for final disposition of award.
SUBSECTION: 106.10 FIELD WELDER CERTIFICATION REQUIREMENTS. REVISION: Insert the following sentence before the first sentence of the first paragraph: All field welding must be performed by a certified welder unless otherwise noted.
SUBSECTION: 112.03.12 Project Traffic Coordinator (PTC). REVISION: Add the following at the end of the subsection: After October 1, 2008 the Department will require the PTC to have successfully completed the applicable qualification courses. Personnel that have not successfully completed the applicable courses by that date will not be considered qualified. Prior to October 1, 2008, conform to Subsection 108.06 A) and ensure the designated PTC has sufficient skill and experience to properly perform the task.
SUBSECTION: 213.03.05 Temporary Control Measures. PART: F) Temporary Mulch. REVISION: Replace the last sentence with the following: Place temporary mulch to an approximate 2-inch loose depth (2 tons per acre) and anchor it into the soil by mechanically crimping it into the soil surface or applying tackifier to provide a protective cover. Regardless of the anchoring method used, ensure the protective cover holds until disturbance is required or permanent controls are in installed.

**Supplemental Specifications to The Standard Specifications
for Road and Bridge Construction, 2008 Edition**

(Effective with the October 31, 2008 Letting)

SUBSECTION:	402.05.02 Asphalt Mixtures and Mixtures With RAP.
PART:	Lot Pay Adjustment Schedule, Compaction Option A, Base and Binder Mixtures
TABLES:	VMA, AV, and LANE DENSITY
REVISION:	Replace the VMA, AV, and LANE DENSITY tables with the following:

VMA	
Pay Value	Deviation From Minimum
1.00	≤ 0.5 below min.
0.95	0.6-1.0 below min.
0.90	1.1-1.5 below min.
⁽¹⁾	> 1.5 below min.

AV		
Pay Value	Test Result (%)	
	ESAL Class 2	ESAL Class 3 or 4
1.00	3.0-5.0	3.0-5.0
1.00 + 0.1 (AV-3.0)	1.5-2.9	2.0-2.9
1.00 + 0.1 (5.0-AV)	5.1-6.0	5.1-6.0
0.75	6.1-6.5	----
⁽¹⁾	< 1.5 or > 6.5	< 2.0 or > 6.0

LANE DENSITY		
Pay Value	Test Result (%)	
	ESAL Class 2	ESAL Class 3 or 4
1.00	92.0-96.5	92.0-96.5
0.95	91.0-91.9	91.0-91.9
0.90	90.0-90.9 or 96.6-97.0	90.0-90.9 or 96.6-97.0
0.85	97.1-98.5	----
0.75	89.0-89.9	----
⁽¹⁾	< 89.0 or > 98.5	< 90.0 or > 97.0

**Supplemental Specifications to The Standard Specifications
for Road and Bridge Construction, 2008 Edition
(Effective with the October 31, 2008 Letting)**

SUBSECTION:	402.05.02 Asphalt Mixtures and Mixtures With RAP.
PART:	Lot Pay Adjustment Schedule, Compaction Option A, Surface Mixtures
TABLES:	AV, LANE DENSITY, and JOINT DENSITY
REVISION:	Replace the AV, LANE DENSITY, and JOINT DENSITY tables with the following:

AV		
Pay Value	Test Result (%)	
	ESAL Class 2	ESAL Class 3 or 4
1.00	3.0-5.0	3.0-5.0
1.00 + 0.1 (AV-3.0)	1.5-2.9	2.0-2.9
1.00 + 0.1 (5.0-AV)	5.1-6.0	5.1-6.0
0.75	6.1-6.5	----
⁽¹⁾	< 1.5 or > 6.5	< 2.0 or > 6.0

LANE DENSITY		
Pay Value	Test Result (%)	
	ESAL Class 2	ESAL Class 3 or 4
1.00	92.0-96.5	92.0-96.5
0.95	91.0-91.9	91.0-91.9
0.90	90.0-90.9 or 96.6-97.0	90.0-90.9 or 96.6-97.0
0.85	97.1-98.5	----
0.75	89.0-89.9	----
⁽¹⁾	< 89.0 or > 98.5	< 90.0 or > 97.0

JOINT DENSITY	
Pay Value	Test Result (%)
1.00	89.0-96.5
0.95	88.0-88.9
0.90	87.0-87.9 or 96.6-97.0
0.75	< 87.0 or > 97.0

SUBSECTION:	402.05.02 Asphalt Mixtures and Mixtures With RAP.
PART:	Lot Pay Adjustment Schedule, Compaction Option B Mixtures
TABLE:	AV
REVISION:	Replace the AV table with the following:

AV		
Pay Value	Test Result (%)	
	ESAL Class 2	ESAL Class 3 or 4
1.00	3.0-5.0	3.0-5.0
1.00 + 0.1 (AV-3.0)	1.5-2.9	2.0-2.9
1.00 + 0.1 (5.0-AV)	5.1-6.0	5.1-6.0
0.75	6.1-6.5	----
⁽²⁾	< 1.5 or > 6.5	< 2.0 or > 6.0

SUBSECTION:	410.01 DESCRIPTION.
REVISION:	Delete the second sentence of the paragraph.

**Supplemental Specifications to The Standard Specifications
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SUBSECTION:	410.03.01 Corrective Work.																																																								
REVISION:	Replace the last sentence of the paragraph with the following: Provide a final surface comparable to the adjacent pavement that does not require corrective work in respect to texture, appearance, and skid resistance.																																																								
SUBSECTION:	410.03.02 Ride Quality.																																																								
PART:	B) Requirements.																																																								
NUMBER:	1) Category A.																																																								
REVISION:	Replace the last sentence of the first paragraph with the following: At the Department's discretion, a pay deduction of \$1200 per 0.1-lane-mile section may be applied in lieu of corrective work.																																																								
SUBSECTION:	410.03.02 Ride Quality.																																																								
PART:	B) Requirements.																																																								
NUMBER:	2) Category B.																																																								
REVISION:	Replace the second and third sentence of the first paragraph with the following: When the IRI is greater than 90 for a 0.1-mile section, perform corrective work, or remove and replace the pavement to achieve the specified IRI. At the Department's discretion, a pay deduction of \$750 per 0.1-lane-mile section may be applied in lieu of corrective work.																																																								
SUBSECTION:	410.05 PAYMENT.																																																								
REVISION:	Delete the last sentence of the first paragraph.																																																								
SUBSECTION:	410.05 PAYMENT.																																																								
TABLE:	RIDE QUALITY ADJUSTMENT SCHEDULES																																																								
REVISION:	Replace the adjustment tables with the following: <div style="text-align: center;"> <p>RIDE QUALITY ADJUSTMENT SCHEDULES</p> <table border="0"> <thead> <tr> <th colspan="2">CATEGORY "A" PROJECTS</th> <th colspan="2">CATEGORY "B" PROJECTS</th> </tr> <tr> <th><u>IRI</u></th> <th><u>Pav Value Adjustment</u></th> <th><u>IRI</u></th> <th><u>Pav Value Adjustment</u></th> </tr> </thead> <tbody> <tr> <td>70 or less</td> <td>0</td> <td>80 or less</td> <td>0</td> </tr> <tr> <td>71</td> <td>-\$30</td> <td>81</td> <td>-\$20</td> </tr> <tr> <td>72</td> <td>-\$70</td> <td>82</td> <td>-\$45</td> </tr> <tr> <td>73</td> <td>-\$120</td> <td>83</td> <td>-\$80</td> </tr> <tr> <td>74</td> <td>-\$180</td> <td>84</td> <td>-\$120</td> </tr> <tr> <td>75</td> <td>-\$250</td> <td>85</td> <td>-\$170</td> </tr> <tr> <td>76</td> <td>-\$330</td> <td>86</td> <td>-\$220</td> </tr> <tr> <td>77</td> <td>-\$420</td> <td>87</td> <td>-\$280</td> </tr> <tr> <td>78</td> <td>-\$520</td> <td>88</td> <td>-\$350</td> </tr> <tr> <td>79</td> <td>-\$630</td> <td>89</td> <td>-\$420</td> </tr> <tr> <td>80</td> <td>-\$750</td> <td>90</td> <td>-\$500</td> </tr> <tr> <td>81 or higher</td> <td>corrective work⁽¹⁾</td> <td>91 or higher</td> <td>corrective work⁽²⁾</td> </tr> </tbody> </table> <p>⁽¹⁾When it is in the best interest of the Department, a minimum pay value deduction of \$1200 per 0.1-lane-mile section may be applied in lieu of corrective work. ⁽²⁾When it is in the best interest of the Department, a minimum pay value deduction of \$750 per 0.1-lane-mile section may be applied in lieu of corrective work.</p> </div>	CATEGORY "A" PROJECTS		CATEGORY "B" PROJECTS		<u>IRI</u>	<u>Pav Value Adjustment</u>	<u>IRI</u>	<u>Pav Value Adjustment</u>	70 or less	0	80 or less	0	71	-\$30	81	-\$20	72	-\$70	82	-\$45	73	-\$120	83	-\$80	74	-\$180	84	-\$120	75	-\$250	85	-\$170	76	-\$330	86	-\$220	77	-\$420	87	-\$280	78	-\$520	88	-\$350	79	-\$630	89	-\$420	80	-\$750	90	-\$500	81 or higher	corrective work ⁽¹⁾	91 or higher	corrective work ⁽²⁾
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SUBSECTION:	509.01 DESCRIPTION.																																																								
REVISION:	Replace the second paragraph with the following: The Department may allow the use of similar units that conform to the National Cooperative Highway Research Program (NCHRP) 350 Test Level 3 (TL-3) requirements and the typical features depicted by the Standard Drawings. Obtain the Engineers approval prior to use. Ensure the barrier wall shape, length, material, drain slot dimensions and locations typical features are met and the reported maximum deflection is 3 feet or less from the NCHRP 350 TL-3 for Test 3 – 11 (pickup truck																																																								

**Supplemental Specifications to The Standard Specifications
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impacting at 60 mph at a 25-degree angle.)

SUBSECTION:	606.02.11 Coarse Aggregate.						
REVISION:	Replace with the following: Conform to Section 805, size No. 8 or 9-M.						
SUBSECTION:	701.03.08 Testing of Pipe.						
REVISION:	Replace and rename the subsection with the following: <p>701.03.08 Inspection of Pipe. The engineer will visually inspect all pipe. The Department will require camera/video inspection on a minimum of 50 percent of the linear feet of all installed pipe structures. Conduct camera/video inspection according to KM 64-114. The pipe to be installed under pavement will be selected first. If the total linear feet of pipe under pavement is less than 50 percent of the linear feet of all pipe installed, the Engineer will randomly select installations from the remaining pipe structures on the project to provide for the minimum inspection requirement. The pipe will be selected in complete runs (junction-junction or headwall-headwall) until the total linear feet of pipe to be inspected is at least 50 percent of the total linear feet of all installed pipe on the project.</p> <p>Unless the Engineer directs otherwise, schedule the inspections no sooner than 30 days after completing the installation and completion of earthwork to within 1 foot of the finished subgrade. When final surfacing conflicts with the 30-day minimum, conduct the inspections prior to placement of the final surface. The contractor must ensure that all pipe are free and clear of any debris so that a complete inspection is possible.</p> <p>Notify the Engineer immediately if distresses or locations of improper installation are discovered. When camera testing shows distresses or improper installation in the installed pipe, the Engineer may require additional sections to be tested. Provide the video and report to the Engineer when testing is complete in accordance with KM 64-114.</p> <p>Pipes that exhibit distress or signs of improper installation may necessitate repair or removal as the Engineer directs. These signs include, but are not limited to: deflection, cracking, joint separation, sagging or other interior damage. If corrugated metal or thermoplastic pipes exceed the deflection and installation thresholds indicated in the table below, provide the Department with an evaluation of each location conducted by a Professional Engineer addressing the severity of the deflection, structural integrity, environmental conditions, design service life, and an evaluation of the factor of safety using Section 12, "Buried Structures and Tunnel Liners," of the AASHTO LRFD Bridge Design Specifications. Based on the evaluation, the Department may allow the pipe to remain in place at a reduced unit price as shown in the table below. Provide 5 business days for the Department to review the evaluation. When the pipe shows deflection of 10 percent or greater, remove and replace the pipe. When the camera/video or laser inspection results are called into question, the Department may require direct measurements or mandrel testing.</p> <p>The Cabinet may elect to conduct Quality Assurance verifications of any pipe inspections.</p>						
SUBSECTION:	701.04.07 Testing.						
REVISION:	Replace and rename the subsection with the following: <p>701.04.07 Pipeline Video Inspection. The Department will measure the quantity in linear feet along the pipe invert of the structure inspected. When inspection above the specified 50 percent is performed due to a disagreement or suspicion of additional distresses and the Department is found in error, the Department will measure the quantity as Extra Work according to Subsection 104.03. However, if additional distresses or non-conformance is found, the Department will not measure the additional inspection for payment.</p>						
SUBSECTION:	701.05 PAYMENT.						
REVISION:	Add the following pay item to the list of pay items: <table style="width: 100%; border-collapse: collapse;"> <thead> <tr> <th style="text-align: left;"><u>Code</u></th> <th style="text-align: left;"><u>Pay Item</u></th> <th style="text-align: left;"><u>Pay Unit</u></th> </tr> </thead> <tbody> <tr> <td>23131ER701</td> <td>Pipeline Video Inspection</td> <td>Linear Foot</td> </tr> </tbody> </table>	<u>Code</u>	<u>Pay Item</u>	<u>Pay Unit</u>	23131ER701	Pipeline Video Inspection	Linear Foot
<u>Code</u>	<u>Pay Item</u>	<u>Pay Unit</u>					
23131ER701	Pipeline Video Inspection	Linear Foot					

**Supplemental Specifications to The Standard Specifications
for Road and Bridge Construction, 2008 Edition
(Effective with the October 31, 2008 Letting)**

SUBSECTION:	701.05 PAYMENT										
TABLE:	PIPE DEFLECTION DETERMINED BY CAMERA TESTING										
REVISION:	Replace this table with the following table and note:										
<table border="1"> <thead> <tr> <th colspan="2">PIPE DEFLECTION</th> </tr> <tr> <th>Amount of Deflection (%)</th> <th>Payment</th> </tr> </thead> <tbody> <tr> <td>0.0 to 5.0</td> <td>100% of the Unit Bid Price</td> </tr> <tr> <td>5.1 to 9.9</td> <td>50% of the Unit Bid Price ⁽¹⁾</td> </tr> <tr> <td>10 or greater</td> <td>Remove and Replace</td> </tr> </tbody> </table>		PIPE DEFLECTION		Amount of Deflection (%)	Payment	0.0 to 5.0	100% of the Unit Bid Price	5.1 to 9.9	50% of the Unit Bid Price ⁽¹⁾	10 or greater	Remove and Replace
PIPE DEFLECTION											
Amount of Deflection (%)	Payment										
0.0 to 5.0	100% of the Unit Bid Price										
5.1 to 9.9	50% of the Unit Bid Price ⁽¹⁾										
10 or greater	Remove and Replace										
	(1) <i>Provide Structural Analysis as indicated above. Based on the structural analysis, pipe may be allowed to remain in place at the reduced unit price.</i>										
SUBSECTION:	701.05 PAYMENT										
TABLE:	PIPE DEFLECTION DETERMINED BY MANDREL TESTING										
REVISION:	Delete this table.										
SUBSECTION:	805.01 GENERAL.										
REVISION:	Replace the second paragraph with the following: The Department's List of Approved Materials includes the Aggregate Source List, the list of Class A and Class B Polish-Resistant Aggregate Sources, and the Concrete Restriction List.										
SUBSECTION:	805.04 CONCRETE.										
REVISION:	Replace the "AASHTO T 160" reference in first sentence of the third paragraph with "KM 64-629"										
SUBSECTION:	805.15 GRADATION ACCEPTANCE OF NON-SPECIFICATION COARSE AGGREGATE.										
TABLE:	AGGREGATE SIZE USE										
PART:	Cement Concrete Structures and Incidental Construction										
REVISION:	Replace "9-M for Waterproofing Overlays" with "8 or 9-M for Waterproofing Overlays"										
SUBSECTION:	805.16 SAMPLING AND TESTING.										
REVISION:	Replace the "AASHTO T 160" method with the "KM 64-629" method for the Concrete Beam Expansion Test. Replace the "ASTM D 3042" method with the "KM 64-625" method for Insoluble Residue.										
SUBSECTION:	810.04.01 Coating Requirements.										
REVISION:	Replace the "Subsection 806.07" references with "Subsection 806.06"										
SUBSECTION:	837.03 APPROVAL.										
REVISION:	Replace the last sentence with the following: The Department will sample and evaluate for approval each lot of thermoplastic material delivered for use per contract prior to installation of the thermoplastic material. Do not allow the installation of thermoplastic material until it has been approved by the Division of Materials. Allow the Department a minimum of 10 working days to evaluate and approve thermoplastic material.										
SUBSECTION:	837.03.01 Composition.										
REVISION:	COMPOSITION Table: Replace <table border="1" style="margin-left: 40px;"> <tr> <td>Lead Chromate</td> <td>0.0 max.</td> <td>4.0 min.</td> </tr> </table> with <table border="1" style="margin-left: 40px;"> <tr> <td>Heavy Metals Content</td> <td colspan="2">Comply with 40 CFR 261</td> </tr> </table>	Lead Chromate	0.0 max.	4.0 min.	Heavy Metals Content	Comply with 40 CFR 261					
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SUBSECTION: 805.15 GRADATION ACCEPTANCE OF NON-SPECIFICATION COARSE AGGREGATE.
REVISION: Replace the "SIZES OF COARSE AGGREGATES" table in with the following:

Aggregate Size	Sieve Nominal ⁽³⁾ Maximum Aggregate Size	AMOUNTS FINER THAN EACH LABORATORY SIEVE (SQUARE OPENINGS) PERCENTAGE BY WEIGHT															
		4 inch	3 1/2 inch	3 inch	2 1/2 inch	2 inch	1 1/2 inch	1 inch	3/4 inch	1/2 inch	3/8 inch	No. 4	No. 8	No. 16	No. 30	No. 100	No. 200
1	3 1/2 inch	100	90-100		25-60		0-15		0-5								
2	2 1/2 inch			100	90-100	35-70	0-15		0-5								
23	2 inch			100		40-90	0-15		0-5								
3	2 inch		100		90-100	35-70	0-15		0-5								
357	2 inch		100		95-100	35-70	0-15		0-5								
4	1 1/2 inch				100	90-100	20-55	0-15		0-5							
467	1 1/2 inch				100	95-100	35-70		10-30	0-5							
5	1 inch				100	90-100	20-55	0-10	0-5								
57	1 inch				100	95-100	25-60			0-10	0-5						
610	1 inch				100	85-100	40-75			15-40							
67	3/4 inch				100	90-100	90-100		20-55	0-10	0-5						
68	3/4 inch				100	90-100	90-100		30-65	5-25	0-10	0-5					
710	3/4 inch				100	80-100	80-100		30-75	0-30							
78	1/2 inch				100	100	90-100		40-75	5-25	0-10	0-5					
8	3/8 inch				100	85-100	100		85-100	10-30	0-10	0-5					
9-M	3/8 inch				100	75-100	100		75-100	0-25	0-5						
10 ⁽²⁾	No. 4								100	85-100					10-30		
11 ⁽²⁾	No. 4								100	40-90	10-40				0-5		
DENSE GRADED AGGREGATE ⁽¹⁾	3/4 inch						100	70-100		50-80	30-65			10-40		4-13	
CRUSHED STONE BASE ⁽¹⁾	1 1/2 inch				100			60-95		30-70	15-55			5-20		0-8	

⁽¹⁾ Gradation performed by wet sieve KM 64-620 or AASHTO T 11/T 27.

⁽²⁾ Sizes shown for convenience and are not to be considered as coarse aggregates.

⁽³⁾ Nominal Maximum Size is the largest sieve on the gradation table for an aggregate size on which any material may be retained.

Note: The Department will allow blending of same source/same type aggregate when precise procedures are used such as cold feed, belt, or equivalent and combining of sizes or types of aggregate using the weigh hopper at concrete plants or controlled feed belts at the pugmill to obtain designated sizes.

PART III

EMPLOYMENT, WAGE AND RECORD REQUIREMENTS

**REQUIRED CONTRACT PROVISIONS
FEDERAL-AID CONSTRUCTION CONTRACTS**

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ATTACHMENTS

- A. Employment Preference for Appalachian Contracts
(included in Appalachian contracts only)

I. GENERAL

1. These contract provisions shall apply to all work performed on the contract by the contractor's own organization and with the assistance of workers under the contractor's immediate superintendence and to all work performed on the contract by piecework, station work, or by subcontract.

2. Except as otherwise provided for in each section, the contractor shall insert in each subcontract all of the stipulations contained in these Required Contract Provisions, and further require their inclusion in any lower tier subcontract or purchase order that may in turn be made. The Required Contract Provisions shall not be incorporated by reference in any case. The prime contractor shall be responsible for compliance by any subcontractor or lower tier subcontractor with these Required Contract Provisions.

3. A breach of any of the stipulations contained in these Required Contract Provisions shall be sufficient grounds for termination of the contract.

4. A breach of the following clauses of the Required Contract Provisions may also be grounds for debarment as provided in 29 CFR 5.12:

- Section I, paragraph 2;
- Section IV, paragraphs 1, 2, 3, 4, and 7;
- Section V, paragraphs 1 and 2a through 2g.

5. Disputes arising out of the labor standards provisions of Section IV (except paragraph 5) and Section V of these Required Contract Provisions shall not be subject to the general disputes clause of this contract. Such disputes shall be resolved in accordance with the procedures of the U.S. Department of Labor (DOL) as set forth in 29 CFR 5, 6, and 7. Disputes within the meaning of this clause include disputes between the contractor (or any of its subcontractors) and the contracting agency, the DOL, or the contractor's employees or their representatives.

6. **Selection of Labor:** During the performance of this contract, the contractor shall not:

a. discriminate against labor from any other State, possession, or territory of the United States (except for employment preference for Appalachian contracts, when applicable, as specified in Attachment A), or

b. employ convict labor for any purpose within the limits of the project unless it is labor performed by convicts who are on parole, supervised release, or probation.

II. NONDISCRIMINATION

(Applicable to all Federal-aid construction contracts and to all related subcontracts of \$10,000 or more.)

1. **Equal Employment Opportunity:** Equal employment opportunity (EEO) requirements not to discriminate and to take affirmative action to assure equal opportunity as set forth under laws, executive orders, rules, regulations (28 CFR 35, 29 CFR 1630 and 41 CFR 60) and orders of the Secretary of Labor as modified by the provisions prescribed herein, and imposed pursuant to 23 U.S.C. 140 shall constitute the EEO and specific affirmative action standards for the contractor's project activities under this contract. The Equal Opportunity Construction Contract Specifications set forth under 41 CFR 60-4.3 and the provisions of the American Disabilities Act of 1990 (42 U.S.C. 12101 *et seq.*) set forth under 28 CFR 35 and 29 CFR 1630 are incorporated by reference in this contract. In the execution of this contract, the contractor agrees to comply with the following minimum specific requirement activities of EEO:

a. The contractor will work with the State highway agency (SHA) and the Federal Government in carrying out EEO obligations and in their review of his/her activities under the contract.

b. The contractor will accept as his operating policy the following statement:

"It is the policy of this Company to assure that applicants are employed, and that employees are treated during employment, without regard to their race, religion, sex, color, national origin, age or disability. Such action shall include: employment, upgrading, demotion, or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship, preapprenticeship, and/or on-the-job training."

2. **EEO Officer:** The contractor will designate and make known to the SHA contracting officers an EEO Officer who will have the responsibility for and must be capable of effectively administering and promoting an active contractor program of EEO and who must be assigned adequate authority and responsibility to do so.

3. **Dissemination of Policy:** All members of the contractor's staff who are authorized to hire, supervise, promote, and discharge employees, or who recommend such action, or who are substantially involved in such action, will be made fully cognizant of, and will implement, the contractor's EEO policy and contractual responsibilities to provide EEO in each grade and classification of employment. To ensure that the above agreement will be met, the following actions will be taken as a minimum:

a. Periodic meetings of supervisory and personnel office employees will be conducted before the start of work and then not less often than once every six months, at which time the contractor's EEO policy and its implementation will be reviewed and explained. The meetings will be conducted by the EEO Officer.

b. All new supervisory or personnel office employees will be given a thorough indoctrination by the EEO Officer, covering all major aspects of the contractor's EEO obligations within thirty days following their reporting for duty with the contractor.

c. All personnel who are engaged in direct recruitment for the project will be instructed by the EEO Officer in the contractor's procedures for locating and hiring minority group employees.

d. Notices and posters setting forth the contractor's EEO policy will be placed in areas readily accessible to employees, applicants for employment and potential employees.

e. The contractor's EEO policy and the procedures to implement such policy will be brought to the attention of employees by means of meetings, employee handbooks, or other appropriate means.

4. Recruitment: When advertising for employees, the contractor will include in all advertisements for employees the notation: "An Equal Opportunity Employer." All such advertisements will be placed in publications having a large circulation among minority groups in the area from which the project work force would normally be derived.

a. The contractor will, unless precluded by a valid bargaining agreement, conduct systematic and direct recruitment through public and private employee referral sources likely to yield qualified minority group applicants. To meet this requirement, the contractor will identify sources of potential minority group employees, and establish with such identified sources procedures whereby minority group applicants may be referred to the contractor for employment consideration.

b. In the event the contractor has a valid bargaining agreement providing for exclusive hiring hall referrals, he is expected to observe the provisions of that agreement to the extent that the system permits the contractor's compliance with EEO contract provisions. (The DOL has held that where implementation of such agreements have the effect of discriminating against minorities or women, or obligates the contractor to do the same, such implementation violates Executive Order 11246, as amended.)

c. The contractor will encourage his present employees to refer minority group applicants for employment. Information and procedures with regard to referring minority group applicants will be discussed with employees.

5. Personnel Actions: Wages, working conditions, and employee benefits shall be established and administered, and personnel actions of every type, including hiring, upgrading, promotion, transfer, demotion, layoff, and termination, shall be taken without regard to race, color, religion, sex, national origin, age or disability. The following procedures shall be followed:

a. The contractor will conduct periodic inspections of project sites to insure that working conditions and employee facilities do not indicate discriminatory treatment of project site personnel.

b. The contractor will periodically evaluate the spread of wages paid within each classification to determine any evidence of discriminatory wage practices.

c. The contractor will periodically review selected personnel actions in depth to determine whether there is evidence of discrimination. Where evidence is found, the contractor will promptly take corrective action. If the review indicates that the discrimination may extend beyond the actions reviewed, such corrective action shall include all affected persons.

d. The contractor will promptly investigate all complaints of alleged discrimination made to the contractor in connection with his obligations under this contract, will attempt to resolve such complaints, and will take appropriate corrective action within a reasonable time. If the investigation indicates that the discrimination may affect persons other than the complainant, such corrective action shall include such other persons. Upon completion of each investigation, the contractor will inform every complainant of all of his avenues of appeal.

6. Training and Promotion:

a. The contractor will assist in locating, qualifying, and increasing the skills of minority group and women employees, and applicants for employment.

b. Consistent with the contractor's work force requirements and as permissible under Federal and State regulations, the contractor shall make full use of training programs, i.e., apprenticeship, and on-the-job training programs for the geographical area of contract performance. Where feasible, 25 percent of apprentices or trainees in each occupation shall be in their first year of apprenticeship or training. In the event a special provision for training is provided under this contract, this subparagraph will be superseded as indicated in the special provision.

c. The contractor will advise employees and applicants for employment of available training programs and entrance requirements for each.

d. The contractor will periodically review the training and promotion potential of minority group and women employees and will encourage eligible employees to apply for such training and promotion.

7. Unions: If the contractor relies in whole or in part upon unions as a source of employees, the contractor will use his/her best efforts to obtain the cooperation of such unions to increase opportunities for minority groups and women within the unions, and to effect referrals by such unions of minority and female employees. Actions by the contractor either directly or through a contractor's association acting as agent will include the procedures set forth below:

a. The contractor will use best efforts to develop, in cooperation with the unions, joint training programs aimed toward qualifying more minority group members and women for membership in the unions and increasing the skills of minority group employees and women so that they may qualify for higher paying employment.

b. The contractor will use best efforts to incorporate an EEO clause into each union agreement to the end that such union will be contractually bound to refer applicants without regard to their race, color, religion, sex, national origin, age or disability.

c. The contractor is to obtain information as to the referral practices and policies of the labor union except that to the extent such information is within the exclusive possession of the labor union and such labor union refuses to furnish such information to the contractor, the contractor shall so certify to the SHA and shall set forth what efforts have been made to obtain such information.

d. In the event the union is unable to provide the contractor with a reasonable flow of minority and women referrals within the time limit set forth in the collective bargaining agreement, the contractor will, through independent recruitment efforts, fill the employment vacancies without regard to race, color, religion, sex, national origin,

age or disability; making full efforts to obtain qualified and/or qualifiable minority group persons and women. (The DOL has held that it shall be no excuse that the union with which the contractor has a collective bargaining agreement providing for exclusive referral failed to refer minority employees.) In the event the union referral practice prevents the contractor from meeting the obligations pursuant to Executive Order 11246, as amended, and these special provisions, such contractor shall immediately notify the SHA.

8. Selection of Subcontractors, Procurement of Materials and Leasing of Equipment: The contractor shall not discriminate on the grounds of race, color, religion, sex, national origin, age or disability in the selection and retention of subcontractors, including procurement of materials and leases of equipment.

a. The contractor shall notify all potential subcontractors and suppliers of his/her EEO obligations under this contract.

b. Disadvantaged business enterprises (DBE), as defined in 49 CFR 23, shall have equal opportunity to compete for and perform subcontracts which the contractor enters into pursuant to this contract. The contractor will use his best efforts to solicit bids from and to utilize DBE subcontractors or subcontractors with meaningful minority group and female representation among their employees. Contractors shall obtain lists of DBE construction firms from SHA personnel.

c. The contractor will use his best efforts to ensure subcontractor compliance with their EEO obligations.

9. Records and Reports: The contractor shall keep such records as necessary to document compliance with the EEO requirements. Such records shall be retained for a period of three years following completion of the contract work and shall be available at reasonable times and places for inspection by authorized representatives of the SHA and the FHWA.

a. The records kept by the contractor shall document the following:

(1) The number of minority and non-minority group members and women employed in each work classification on the project;

(2) The progress and efforts being made in cooperation with unions, when applicable, to increase employment opportunities for minorities and women;

(3) The progress and efforts being made in locating, hiring, training, qualifying, and upgrading minority and female employees; and

(4) The progress and efforts being made in securing the services of DBE subcontractors or subcontractors with meaningful minority and female representation among their employees.

b. The contractors will submit an annual report to the SHA each July for the duration of the project, indicating the number of minority, women, and non-minority group employees currently engaged in each work classification required by the contract work. This information is to be reported on Form FHWA-1391. If on-the-job training is being required by special provision, the contractor will be required to collect and report training data.

III. NONSEGREGATED FACILITIES

(Applicable to all Federal-aid construction contracts and to all related subcontracts of \$10,000 or more.)

a. By submission of this bid, the execution of this contract or subcontract, or the consummation of this material supply agreement or purchase order, as appropriate, the bidder, Federal-aid construction contractor, subcontractor, material supplier, or vendor, as appropriate, certifies that the firm does not maintain or provide for its employees any segregated facilities at any of its establishments, and that the firm does not permit its employees to perform their services at any location, under its control, where segregated facilities are maintained. The firm agrees that a breach of this certification is a violation of the EEO provisions of this contract. The firm further certifies that no employee will be denied access to adequate facilities on the basis of sex or disability.

b. As used in this certification, the term "segregated facilities" means any waiting rooms, work areas, restrooms and washrooms, restaurants and other eating areas, timeclocks, locker rooms, and other storage or dressing areas, parking lots, drinking fountains, recreation or entertainment areas, transportation, and housing facilities provided for employees which are segregated by explicit directive, or are, in fact, segregated on the basis of race, color, religion, national origin, age or disability, because of habit, local custom, or otherwise. The only exception will be for the disabled when the demands for accessibility override (e.g. disabled parking).

c. The contractor agrees that it has obtained or will obtain identical certification from proposed subcontractors or material suppliers prior to award of subcontracts or consummation of material supply agreements of \$10,000 or more and that it will retain such certifications in its files.

IV. PAYMENT OF PREDETERMINED MINIMUM WAGE

(Applicable to all Federal-aid construction contracts exceeding \$2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural minor collectors, which are exempt.)

1. General:

a. All mechanics and laborers employed or working upon the site of the work will be paid unconditionally and not less often than once a week and without subsequent deduction or rebate on any account [except such payroll deductions as are permitted by regulations (29 CFR 3) issued by the Secretary of Labor under the Copeland Act (40 U.S.C. 276c)] the full amounts of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment. The payment shall be computed at wage rates not less than those contained in the wage determination of the Secretary of Labor (hereinafter "the wage determination") which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor or its subcontractors and such laborers and mechanics. The wage determination (including any additional classifications and wage rates conformed under paragraph 2 of this Section IV and the DOL poster (WH-1321) or Form FHWA-1495) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers. For the purpose of this Section, contributions made or costs reasonably anticipated for bona fide fringe benefits under Section 1(b)(2) of the Davis-Bacon Act (40 U.S.C. 276a) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of Section IV, paragraph 3b, hereof. Also, for the purpose of this Section, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs, which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics

shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in paragraphs 4 and 5 of this Section IV.

b. Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein, provided, that the employer's payroll records accurately set forth the time spent in each classification in which work is performed.

c. All rulings and interpretations of the Davis-Bacon Act and related acts contained in 29 CFR 1, 3, and 5 are herein incorporated by reference in this contract.

2. Classification:

a. The SHA contracting officer shall require that any class of laborers or mechanics employed under the contract, which is not listed in the wage determination, shall be classified in conformance with the wage determination.

b. The contracting officer shall approve an additional classification, wage rate and fringe benefits only when the following criteria have been met:

(1) the work to be performed by the additional classification requested is not performed by a classification in the wage determination;

(2) the additional classification is utilized in the area by the construction industry;

(3) the proposed wage rate, including any bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination; and

(4) with respect to helpers, when such a classification prevails in the area in which the work is performed.

c. If the contractor or subcontractors, as appropriate, the laborers and mechanics (if known) to be employed in the additional classification or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by the contracting officer to the DOL, Administrator of the Wage and Hour Division, Employment Standards Administration, Washington, D.C. 20210. The Wage and Hour Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

d. In the event the contractor or subcontractors, as appropriate, the laborers or mechanics to be employed in the additional classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer shall refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Wage and Hour Administrator for determination. Said Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary

e. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph 2c or 2d of this Section IV shall be paid to all workers performing work in the additional classification from the first day on which work is performed in the classification.

3. Payment of Fringe Benefits:

a. Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor or subcontractors, as appropriate, shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly case equivalent thereof.

b. If the contractor or subcontractor, as appropriate, does not make payments to a trustee or other third person, he/she may consider as a part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, provided, that the Secretary of Labor has found, upon the written request of the contractor, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account assets for the meeting of obligations under the plan or program.

4. Apprentices and Trainees (Programs of the U.S. DOL) and Helpers:

a. Apprentices:

(1) Apprentices will be permitted to work at less than the predetermined rate for the work they performed when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the DOL, Employment and Training Administration, Bureau of Apprenticeship and Training, or with a State apprenticeship agency recognized by the Bureau, or if a person is employed in his/her first 90 days of probationary employment as an apprentice in such an apprenticeship program, who is not individually registered in the program, but who has been certified by the Bureau of Apprenticeship and Training or a State apprenticeship agency (where appropriate) to be eligible for probationary employment as an apprentice.

(2) The allowable ratio of apprentices to journeyman-level employees on the job site in any craft classification shall not be greater than the ratio permitted to the contractor as to the entire work force under the registered program. Any employee listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated above, shall be paid not less than the applicable wage rate listed in the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. Where a contractor or subcontractor is performing construction on a project in a locality other than that in which its program is registered, the ratios and wage rates (expressed in percentages of the journeyman-level hourly rate) specified in the contractor's or subcontractor's registered program shall be observed.

(3) Every apprentice must be paid at not less than the rate specified in the registered program for the apprentice's level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Apprentices shall be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable

classification. If the Administrator for the Wage and Hour Division determines that a different practice prevails for the applicable apprentice classification, fringes shall be paid in accordance with that determination.

(4) In the event the Bureau of Apprenticeship and Training, or a State apprenticeship agency recognized by the Bureau, withdraws approval of an apprenticeship program, the contractor or subcontractor will no longer be permitted to utilize apprentices at less than the applicable predetermined rate for the comparable work performed by regular employees until an acceptable program is approved.

b. Trainees:

(1) Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the DOL, Employment and Training Administration.

(2) The ratio of trainees to journeyman-level employees on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(3) Every trainee must be paid at not less than the rate specified in the approved program for his/her level of progress, expressed as a percentage of the journeyman-level hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman-level wage rate on the wage determination which provides for less than full fringe benefits for apprentices, in which case such trainees shall receive the same fringe benefits as apprentices.

(4) In the event the Employment and Training Administration withdraws approval of a training program, the contractor or subcontractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

c. Helpers:

Helpers will be permitted to work on a project if the helper classification is specified and defined on the applicable wage determination or is approved pursuant to the conformance procedure set forth in Section IV.2. Any worker listed on a payroll at a helper wage rate, who is not a helper under an approved definition, shall be paid not less than the applicable wage rate on the wagedetermination for the classification of work actually performed.

5. Apprentices and Trainees (Programs of the U.S. DOT):

Apprentices and trainees working under apprenticeship and skill training programs which have been certified by the Secretary of

Transportation as promoting EEO in connection with Federal-aid highway construction programs are not subject to the requirements of paragraph 4 of this Section IV. The straight time hourly wage rates for apprentices and trainees under such programs will be established by the particular programs. The ratio of apprentices and trainees to journeymen shall not be greater than permitted by the terms of the particular program.

6. Withholding:

The SHA shall upon its own action or upon written request of an authorized representative of the DOL withhold, or cause to be withheld, from the contractor or subcontractor under this contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to Davis-Bacon prevailing wage requirements which is held by the same prime contractor, as much of the accrued payments or advances as may be considered necessary to pay laborers and mechanics, including apprentices, trainees, and helpers, employed by the contractor or any subcontractor the full amount of wages required by the contract. In the event of failure to pay any laborer or mechanic, including any apprentice, trainee, or helper, employed or working on the site of the work, all or part of the wages required by the contract, the SHA contracting officer may, after written notice to the contractor, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

7. Overtime Requirements:

No contractor or subcontractor contracting for any part of the contract work which may require or involve the employment of laborers, mechanics, watchmen, or guards (including apprentices, trainees, and helpers described in paragraphs 4 and 5 above) shall require or permit any laborer, mechanic, watchman, or guard in any workweek in which he/she is employed on such work, to work in excess of 40 hours in such workweek unless such laborer, mechanic, watchman, or guard receives compensation at a rate not less than one-and-one-half times his/her basic rate of pay for all hours worked in excess of 40 hours in such workweek.

8. Violation:

Liability for Unpaid Wages; Liquidated Damages: In the event of any violation of the clause set forth in paragraph 7 above, the contractor and any subcontractor responsible thereof shall be liable to the affected employee for his/her unpaid wages. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory) for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer, mechanic, watchman, or guard employed in violation of the clause set forth in paragraph 7, in the sum of \$10 for each calendar day on which such employee was required or permitted to work in excess of the standard work week of 40 hours without payment of the overtime wages required by the clause set forth in paragraph 7.

9. Withholding for Unpaid Wages and Liquidated Damages:

The SHA shall upon its own action or upon written request of any authorized representative of the DOL withhold, or cause to be withheld, from any monies payable on account of work performed by the contractor or subcontractor under any such contract or any other Federal contract with the same prime contractor, or any other Federally-assisted contract subject to the Contract Work Hours and Safety Standards Act, which is held by the same prime contractor, such sums as may be determined to be necessary to satisfy any

liabilities of such contractor or subcontractor for unpaid wages and liquidated damages as provided in the clause set forth in paragraph 8 above.

V. STATEMENTS AND PAYROLLS

(Applicable to all Federal-aid construction contracts exceeding \$2,000 and to all related subcontracts, except for projects located on roadways classified as local roads or rural collectors, which are exempt.)

1. Compliance with Copeland Regulations (29 CFR 3):

The contractor shall comply with the Copeland Regulations of the Secretary of Labor which are herein incorporated by reference.

2. Payrolls and Payroll Records:

a. Payrolls and basic records relating thereto shall be maintained by the contractor and each subcontractor during the course of the work and preserved for a period of 3 years from the date of completion of the contract for all laborers, mechanics, apprentices, trainees, watchmen, helpers, and guards working at the site of the work.

b. The payroll records shall contain the name, social security number, and address of each such employee; his or her correct classification; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalent thereof the types described in Section 1(b)(2)(B) of the Davis Bacon Act); daily and weekly number of hours worked; deductions made; and actual wages paid. In addition, for Appalachian contracts, the payroll records shall contain a notation indicating whether the employee does, or does not, normally reside in the labor area as defined in Attachment A, paragraph 1. Whenever the Secretary of Labor, pursuant to Section IV, paragraph 3b, has found that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in Section 1(b)(2)(B) of the Davis Bacon Act, the contractor and each subcontractor shall maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, that the plan or program has been communicated in writing to the laborers or mechanics affected, and show the cost anticipated or the actual cost incurred in providing benefits. Contractors or subcontractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprentices and trainees, and ratios and wage rates prescribed in the applicable programs.

c. Each contractor and subcontractor shall furnish, each week in which any contract work is performed, to the SHA resident engineer a payroll of wages paid each of its employees (including apprentices, trainees, and helpers, described in Section IV, paragraphs 4 and 5, and watchmen and guards engaged on work during the preceding weekly payroll period). The payroll submitted required to be maintained under paragraph 2b of this Section V. This information may be submitted in any form desired. Optional Form WH-347 is available for this purpose and may be purchased from the Superintendent of Documents (Federal stock number 029-005-0014-1), U.S. Government Printing Office, Washington, D.C. 20402. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors.

d. Each payroll submitted shall be accompanied by a "Statement of Compliance," signed by the contractor or subcontractor or his/her agent who pays or supervises the payment of the persons employed under the contract and shall certify the following:

(1) that the payroll for the payroll period contains the information required to be maintained under paragraph 2b of this Section V and that such information is correct and complete;

(2) that such laborer or mechanic (including each helper, apprentice, and trainee) employed on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in the Regulations, 29 CFR 3;

(3) that each laborer or mechanic has been paid not less than the applicable wage rate and fringe benefits or cash equivalent for the classification of work performed, as specified in the applicable wage determination incorporated into the contract.

e. The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 shall satisfy the requirement for submission of the "Statement of Compliance" required by paragraph 2d of this Section V.

f. The falsification of any of the above certifications may subject the contractor to civil or criminal prosecution under 18 U.S.C. 1001 and 31 U.S.C. 231.

g. The contractor or subcontractor shall make the records required under paragraph 2b of this Section V available for inspection, copying, or transcription by authorized representatives of the SHA, the FHWA, or the DOL, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the SHA, the FHWA, the DOL, or all may, after written notice to the contractor, sponsor, applicant, or owner, take such actions as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

VI. RECORD OF MATERIALS, SUPPLIES, AND LABOR

1. On all Federal-aid contracts on the National Highway System, except those which provide solely for the installation of protective devices at railroad grade crossings, those which are constructed on a force account or direct labor basis, highway beautification contracts, and contracts for which the total final construction cost for roadway and bridge is less than \$1,000,000 (23 CFR 635) the contractor shall:

a. Become familiar with the list of specific materials and supplies contained in Form FHWA-47, "Statement of Materials and Labor Used by Contractor of Highway Construction Involving Federal Funds," prior to the commencement of work under this contract.

b. Maintain a record of the total cost of all materials and supplies purchased for and incorporated in the work, and also of the quantities of those specific materials and supplies listed on Form FHWA-47, and in the units shown on Form FHWA-47.

c. Furnish, upon the completion of the contract, to the SHA resident engineer on Form FHWA-47 together with the data required in paragraph 1b relative to materials and supplies, a final labor summary of all contract work indicating the total hours worked and the total amount earned.

2. At the prime contractor's option, either a single report covering all contract work or separate reports for the contractor and for each subcontract shall be submitted.

VII. SUBLETTING OR ASSIGNING THE CONTRACT

1. The contractor shall perform with its own organization contract work amounting to not less than 30 percent (or a greater percentage if specified elsewhere in the contract) of the total original contract price, excluding any specialty items designated by the State. Specialty items may be performed by subcontract and the amount of any such specialty items performed may be deducted from the total original contract price before computing the amount of work required to be performed by the contractor's own organization (23 CFR 635).

a. "Its own organization" shall be construed to include only workers employed and paid directly by the prime contractor and equipment owned or rented by the prime contractor, with or without operators. Such term does not include employees or equipment of a subcontractor, assignee, or agent of the prime contractor.

b. "Specialty Items" shall be construed to be limited to work that requires highly specialized knowledge, abilities, or equipment not ordinarily available in the type of contracting organizations qualified and expected to bid on the contract as a whole and in general are to be limited to minor components of the overall contract.

2. The contract amount upon which the requirements set forth in paragraph 1 of Section VII is computed includes the cost of material and manufactured products which are to be purchased or produced by the contractor under the contract provisions.

3. The contractor shall furnish (a) a competent superintendent or supervisor who is employed by the firm, has full authority to direct performance of the work in accordance with the contract requirements, and is in charge of all construction operations (regardless of who performs the work) and (b) such other of its own organizational resources (supervision, management, and engineering services) as the SHA contracting officer determines is necessary to assure the performance of the contract.

4. No portion of the contract shall be sublet, assigned or otherwise disposed of except with the written consent of the SHA contracting officer, or authorized representative, and such consent when given shall not be construed to relieve the contractor of any responsibility for the fulfillment of the contract. Written consent will be given only after the SHA has assured that each subcontract is evidenced in writing and that it contains all pertinent provisions and requirements of the prime contract.

VIII. SAFETY: ACCIDENT PREVENTION

1. In the performance of this contract the contractor shall comply with all applicable Federal, State, and local laws governing safety, health, and sanitation (23 CFR 635). The contractor shall provide all safeguards, safety devices and protective equipment and take any other needed actions as it determines, or as the SHA contracting officer may determine, to be reasonably necessary to protect the life and health of employees on the job and the safety of the public and to protect property in connection with the performance of the work covered by the contract.

2. It is a condition of this contract, and shall be made a condition of each subcontract, which the contractor enters into pursuant to this contract, that the contractor and any subcontractor shall not permit any employee, in performance of the contract, to work in surroundings or under conditions which are unsanitary, hazardous or dangerous to his/her health or safety, as determined under construction safety and health standards (29 CFR 1926) promulgated by the Secretary of Labor, in accordance with Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

3. Pursuant to 29 CFR 1926.3, it is a condition of this contract that the Secretary of Labor or authorized representative thereof, shall have right of entry to any site of contract performance to inspect or investigate the matter of compliance with the construction safety and health standards and to carry out the duties of the Secretary under Section 107 of the Contract Work Hours and Safety Standards Act (40 U.S.C. 333).

IX. FALSE STATEMENTS CONCERNING HIGHWAY PROJECTS

In order to assure high quality and durable construction in conformity with approved plans and specifications and a high degree of reliability on statements and representations made by engineers, contractors, suppliers, and workers on Federal-aid highway projects, it is essential that all persons concerned with the project perform their functions as carefully, thoroughly, and honestly as possible. Willful falsification, distortion, or misrepresentation with respect to any facts related to the project is a violation of Federal law. To prevent any misunderstanding regarding the seriousness of these and similar acts, the following notice shall be posted on each Federal-aid highway project (23 CFR 635) in one or more places where it is readily available to all persons concerned with the project:

NOTICE TO ALL PERSONNEL ENGAGED ON FEDERAL-AID HIGHWAY PROJECTS

18 U.S.C. 1020 reads as follows:

"Whoever, being an officer, agent, or employee of the United States, or of any State or Territory, or whoever, whether a person, association, firm, or corporation, knowingly makes any false statement, false representation, or false report as to the character, quality, quantity, or cost of the material used or to be used, or the quantity or quality of the work performed or to be performed, or the cost thereof in connection with the submission of plans, maps, specifications, contracts, or costs of construction on any highway or related project submitted for approval to the Secretary of Transportation; or

Whoever knowingly makes any false statement, false representation, false report or false claim with respect to the character, quality, quantity, or cost of any work performed or to be performed, or materials furnished or to be furnished, in connection with the construction of any highway or related project approved by the Secretary of Transportation; or

Whoever knowingly makes any false statement or false representation as to material fact in any statement, certificate, or report submitted pursuant to provisions of the Federal-aid Roads Act approved July 1, 1916, (39 Stat. 355), as amended and supplemented;

Shall be fined not more than \$10,000 or imprisoned not more than 5 years or both."

X. IMPLEMENTATION OF CLEAN AIR ACT AND FEDERAL WATER POLLUTION CONTROL ACT

(Applicable to all Federal-aid construction contracts and to all related subcontracts of \$100,000 or more.)

By submission of this bid or the execution of this contract, or subcontract, as appropriate, the bidder, Federal-aid construction contractor, or subcontractor, as appropriate, will be deemed to have stipulated as follows:

1. That any facility that is or will be utilized in the performance of this contract, unless such contract is exempt under the Clean Air Act, as amended (42 U.S.C. 1857 et seq., as amended by Pub.L. 91-604), and under the Federal Water Pollution Control Act, as amended (33 U.S.C. 1251 et seq., as amended by Pub.L. 92-500), Executive Order 11738, and regulations in implementation thereof (40 CFR 15) is not listed, on the date of contract award, on the U.S. Environmental Protection Agency (EPA) List of Violating Facilities pursuant to 40 CFR 15.20.

2. That the firm agrees to comply and remain in compliance with all the requirements of Section 114 of the Clean Air Act and Section 308 of the Federal Water Pollution Control Act and all regulations and guidelines listed thereunder.

3. That the firm shall promptly notify the SHA of the receipt of any communication from the Director, Office of Federal Activities, EPA, indicating that a facility that is or will be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

4. That the firm agrees to include or cause to be included the requirements of paragraph 1 through 4 of this Section X in every nonexempt subcontract, and further agrees to take such action as the government may direct as a means of enforcing such requirements.

XI. CERTIFICATION REGARDING DEBARMENT, SUSPENSION, INELIGIBILITY AND VOLUNTARY EXCLUSION

1. Instructions for Certification - Primary Covered Transactions:

(Applicable to all Federal-aid contracts - 49 CFR 29)

a. By signing and submitting this proposal, the prospective primary participant is providing the certification set out below.

b. The inability of a person to provide the certification set out below will not necessarily result in denial of participation in this covered transaction. The prospective participant shall submit an explanation of why it cannot provide the certification set out below. The certification or explanation will be considered in connection with the department or agency's determination whether to enter into this transaction. However, failure of the prospective primary participant to furnish a certification or an explanation shall disqualify such a person from participation in this transaction.

c. The certification in this clause is a material representation of fact upon which reliance was placed when the department or agency determined to enter into this transaction. If it is later determined that the prospective primary participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause of default.

d. The prospective primary participant shall provide immediate written notice to the department or agency to whom this proposal is submitted if any time the prospective primary participant learns that its certification was erroneous when submitted or has become erroneous by reason of changed circumstances.

e. The terms "covered transaction," "debarred," "suspended," "ineligible," "lower tier covered transaction," "participant," "person," "primary covered transaction," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the department or agency to which

this proposal is submitted for assistance in obtaining a copy of those regulations.

f. The prospective primary participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency entering into this transaction.

g. The prospective primary participant further agrees by submitting this proposal that it will include the clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," provided by the department or agency entering into this covered transaction, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

h. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the nonprocurement portion of the "Lists of Parties Excluded From Federal Procurement or Nonprocurement Programs" (Nonprocurement List) which is compiled by the General Services Administration.

i. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

j. Except for transactions authorized under paragraph f of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency may terminate this transaction for cause or default.

* * * * *

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Primary Covered Transactions

1. The prospective primary participant certifies to the best of its knowledge and belief, that it and its principals:

a. Are not presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency;

b. Have not within a 3-year period preceding this proposal been convicted of or had a civil judgement rendered against them for commission of fraud or a criminal offense in connection with obtaining, attempting to obtain, or performing a public (Federal, State or local) transaction or contract under a public transaction; violation of Federal or State antitrust statutes or commission of embezzlement, theft, forgery, bribery, falsification or destruction of records, making false statements, or receiving stolen property;

c. Are not presently indicted for or otherwise criminally or civilly charged by a governmental entity (Federal, State or local) with commission of any of the offenses enumerated in paragraph 1b of this certification; and

d. Have not within a 3-year period preceding this application/proposal had one or more public transactions (Federal, State or local) terminated for cause or default.

2. Where the prospective primary participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

2. Instructions for Certification - Lower Tier Covered Transactions:

(Applicable to all subcontracts, purchase orders and other lower tier transactions of \$25,000 or more - 49 CFR 29)

a. By signing and submitting this proposal, the prospective lower tier is providing the certification set out below.

b. The certification in this clause is a material representation of fact upon which reliance was placed when this transaction was entered into. If it is later determined that the prospective lower tier participant knowingly rendered an erroneous certification, in addition to other remedies available to the Federal Government, the department, or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

c. The prospective lower tier participant shall provide immediate written notice to the person to which this proposal is submitted if at any time the prospective lower tier participant learns that its certification was erroneous by reason of changed circumstances.

d. The terms "covered transaction," "debarred," "suspended," "ineligible," "primary covered transaction," "participant," "person," "principal," "proposal," and "voluntarily excluded," as used in this clause, have the meanings set out in the Definitions and Coverage sections of rules implementing Executive Order 12549. You may contact the person to which this proposal is submitted for assistance in obtaining a copy of those regulations.

e. The prospective lower tier participant agrees by submitting this proposal that, should the proposed covered transaction be entered into, it shall not knowingly enter into any lower tier covered transaction with a person who is debarred, suspended, declared ineligible, or voluntarily excluded from participation in this covered transaction, unless authorized by the department or agency with which this transaction originated.

f. The prospective lower tier participant further agrees by submitting this proposal that it will include this clause titled "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions.

g. A participant in a covered transaction may rely upon a certification of a prospective participant in a lower tier covered transaction that is not debarred, suspended, ineligible, or voluntarily excluded from the covered transaction, unless it knows that the certification is erroneous. A participant may decide the method and frequency by which it determines the eligibility of its principals. Each participant may, but is not required to, check the Nonprocurement List.

h. Nothing contained in the foregoing shall be construed to require establishment of a system of records in order to render in good faith the certification required by this clause. The knowledge and information of participant is not required to exceed that which is normally possessed by a prudent person in the ordinary course of business dealings.

i. Except for transactions authorized under paragraph e of these instructions, if a participant in a covered transaction knowingly enters into a lower tier covered transaction with a person who is suspended, debarred, ineligible, or voluntarily excluded from participation in this transaction, in addition to other remedies available to the Federal Government, the department or agency with which this transaction originated may pursue available remedies, including suspension and/or debarment.

Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion--Lower Tier Covered Transactions:

1. The prospective lower tier participant certifies, by submission of this proposal, that neither it nor its principals is presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from participation in this transaction by any Federal department or agency.

2. Where the prospective lower tier participant is unable to certify to any of the statements in this certification, such prospective participant shall attach an explanation to this proposal.

XII. CERTIFICATION REGARDING USE OF CONTRACT FUNDS FOR LOBBYING

(Applicable to all Federal-aid construction contracts and to all related subcontracts which exceed \$100,000 - 49 CFR 20)

1. The prospective participant certifies, by signing and submitting this bid or proposal, to the best of his or her knowledge and belief, that:

a. No Federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any Federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

b. If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any Federal agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and

submit Standard Form-LLL, "Disclosure Form to Report Lobbying," in accordance with its instructions.

2. This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by 31 U.S.C. 1352. Any person who fails to file the required certification shall be subject to a civil penalty of not less than \$10,000 and not more than \$100,000 for each such failure.

3. The prospective participant also agrees by submitting his or her bid or proposal that he or she shall require that the language of this certification be included in all lower tier subcontracts, which exceed \$100,000 and that all such recipients shall certify and disclose accordingly.

**KENTUCKY TRANSPORTATION CABINET
DEPARTMENT OF HIGHWAYS**

**EMPLOYMENT REQUIREMENTS
RELATING TO
NONDISCRIMINATION OF EMPLOYEES
(APPLICABLE TO FEDERAL-AID SYSTEM CONTRACTS)**

**AN ACT OF THE KENTUCKY GENERAL ASSEMBLY
TO PREVENT DISCRIMINATION IN EMPLOYMENT**

**KRS CHAPTER 344
EFFECTIVE JUNE 16, 1972**

The contract on this project, in accordance with KRS Chapter 344, provides that during the performance of this contract, the contractor agrees as follows:

1. The contractor shall not fail or refuse to hire, or shall not discharge any individual, or otherwise discriminate against an individual with respect to his compensation, terms, conditions, or privileges of employment, because of such individual's race, color, religion, national origin, sex, disability or age (between forty and seventy); or limit, segregate, or classify his employees in any way which would deprive or tend to deprive an individual of employment opportunities or otherwise adversely affect his status as an employee, because of such individual's race, color, religion, national origin, sex, disability or age (between forty and seventy). The contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices to be provided setting forth the provisions of this nondiscrimination clause.

2. The contractor shall not print or publish or cause to be printed or published a notice or advertisement relating to employment by such an employer or membership in or any classification or referral for employment by the employment agency, indicating any preference, limitation, specification, or discrimination, based on race, color, religion, national origin, sex, disability or age (between forty and seventy), except that such notice or advertisement may indicate a preference, limitation, or specification based on religion, or national origin when religion, or national origin is a bona fide occupational qualification for employment.

3. If the contractor is in control of apprenticeship or other training or retraining, including on-the-job training programs, he shall not discriminate against an individual because of his race, color, religion, national origin, sex, disability or age (between forty and seventy), in admission to, or employment in any program established to

provide apprenticeship or other training.

4. The contractor will send to each labor union or representative of workers with which he has a collective bargaining agreement or other contract or understanding, a notice to be provided advising the said labor union or workers' representative of the contractor's commitments under this section, and shall post copies of the notice in conspicuous places available to employees and applicants for employment. The contractor will take such action with respect to any subcontract or purchase order as the administering agency may direct as a means of enforcing such provisions, including sanctions for non-compliance.

REVISED: 12-3-92

EXECUTIVE BRANCH CODE OF ETHICS

In the 1992 regular legislative session, the General Assembly passed and Governor Brereton Jones signed Senate Bill 63 (codified as KRS 11A), the Executive Branch Code of Ethics, which states, in part:

KRS 11A.040 (6) provides:

No present or former public servant shall, within six (6) months of following termination of his office or employment, accept employment, compensation or other economic benefit from any person or business that contracts or does business with the state in matters in which he was directly involved during his tenure. This provision shall not prohibit an individual from returning to the same business, firm, occupation, or profession in which he was involved prior to taking office or beginning his term of employment, provided that, for a period of six (6) months, he personally refrains from working on any matter in which he was directly involved in state government. This subsection shall not prohibit the performance of ministerial functions, including, but not limited to, filing tax returns, filing applications for permits or licenses, or filing incorporation papers.

KRS 11A.040 (8) states:

A former public servant shall not represent a person in a matter before a state agency in which the former public servant was directly involved, for a period of one (1) year after the latter of:

- a) The date of leaving office or termination of employment; or
- b) The date the term of office expires to which the public servant was elected.

This law is intended to promote public confidence in the integrity of state government and to declare as public policy the idea that state employees should view their work as a public trust and not as a way to obtain private benefits.

If you have worked for the executive branch of state government within the past six months, you may be subject to the law's prohibitions. The law's applicability may be different if you hold elected office or are contemplating representation of another before a state agency.

Also, if you are affiliated with a firm which does business with the state and which employs former state executive-branch employees, you should be aware that the law may apply to them.

In case of doubt, the law permits you to request an advisory opinion from the Executive Branch Ethics Commission, Room 136, Capitol Building, 700 Capitol Avenue, Frankfort, Kentucky 40601; telephone (502) 564-7954.

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

	HIGHWAY BASIC HOURLY RATES	FRINGE BENEFIT PAYMENTS COMBINED
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CRAFTS:

Ballard, Butler, Caldwell, Carlisle, Crittenden, Daviess, Edmonson, Fulton, Graves, Hancock, Henderson, Hickman, Hopkins, Livingston, Lyon, Marshall, McCracken, McLean, Muhlenberg, Ohio, Union & Webster Counties:

Bricklayers26.20.....11.55

Allen, Calloway, Christian, Logan, Simpson, Todd, Trigg & Warren Counties:

Bricklayers25.10.....1.60

All Counties:

Carpenters24.84.....10.23

Divers37.64.....10.23

Piledrivermen25.09.....10.23

Butler, Edmonson, Logan, Todd & Warren Counties:

Electricians25.91.....23.5% + 4.55

Allen & Simpson Counties:

Electricians21.40.....9.75

Ballard, Caldwell, Calloway, Carlisle, Christian, Crittenden, Fulton (Except a 5 mile radius of City Hall in Fulton), Graves, Hickman, Livingston, Lyon, Marshall, McCracken & Trigg Counties:

Electricians:

Electricians28.02.....25.5% + 5.15

Cable Splicers receive \$.25 per hour additional.

Daviess, Hancock, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union & Webster Counties:

Electricians:

Electricians26.66.....27.85% + 5.34

Heilarc Welding & Cable Splicing26.91.....27.85% + 5.34

Fulton County (Up to a 5 mile radius of City Hall in Fulton):

Electricians18.50.....9.99

Cable Splicers19.00.....9.99

Butler County (Eastern eighth, including the Townships of Decker, Lee & Tilford);

Edmonson County (Northern three-fourths, including the Townships of Asphalt, Bee Spring, Brownsville, Grassland, Huff, Kyrock, Lindseyville, Mammoth Cave, Ollie, Prosperity, Rhoda, Sunfish & Sweden):

Ironworkers:

Structural; Ornamental; Reinforcing;

Precast Concrete Erectors23.93.....16.74

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

HIGHWAY BASIC HOURLY RATES	FRINGE BENEFIT PAYMENTS COMBINED
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CRAFTS: (continued)

Butler County (Townships of Aberdeen, Bancock, Casey, Dexterville, Dunbar, Elfie, Gilstrap, Huntsville, Logansport, Monford, Morgantown, Provo, Rochester, and South Hill & Welchs Creek);

Caldwell County (Northeastern third, including the Township of Creswell); Christian County (Northern third, including Townships of Apex, Crofton, Kelly, Mannington and Wynns); Crittenden County (Northeastern half, including the Townships of Grove, Mattoon, Repton, Shady Grove and Tribune); Muhlenberg County (Townships of Bavier, Beech Creek Junction, Benton, Brennen, Browder, Central City, Cleaton, Depoy, Drakesboro, Eunis, Graham, Hillside, Luzerne, Lynn City, Martwick, McNary, Moorman, Millport, Nelson, Paradise, Powderly, South Carrollton, Tarina and Weir);

Daviess, Hancock, Henderson, Hopkins, McLean, Ohio, Union and Webster Counties:

Ironworkers24.75.....14.225

Butler County (Southern third, including the Townships of Boston, Berrys Lick, Dimple, Jetson, Quality, Sharer, Sugar Grove and Woodbury);

Christian County (Eastern two-thirds, including the Townships of Bennettstown, Casky, Herndon, Hopkinsville, Howell, Masonville, Pembroke and Thompsonville);

Edmonson County (Southern fourth, including the Townships of Chalybeate & Rocky Hill);

Muhlenberg County (Southern eighth, including the Townships of Dunnior, Penrod & Rosewood);

Allen, Logan, Simpson, Todd and Warren Counties:

Ironworkers21.60.....9.45

Caldwell County (Southwestern two-thirds, including the Townships of Cedar Bluff, Cider, Claxton, Cobb, Crowtown, Dulaney, Farmersville, Fredonia, McGowan, Otter Pond and Princeton);

Christian County (Western third, excluding the Townships of Apex, Crofton, Kelly, Mannington, Wynns, Bennettstown, Casky, Herndon, Hopkinsville, Howell, Masonville, Pembroke and Thompsonville);

Crittenden County (Southwestern half, including the Townships of Crayne, Dycusburg, Frances, Marion, Mexico, Midway, Sheridan and Told);

Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken and Trigg Counties:

Ironworkers

Projects with a total contract cost of \$20,000,000.00 or above

.....24.74.....15.04

All other work.....23.44.....13.98

Allen, Butler, Edmonson, Logan, Simpson & Warren Counties:

Millwrights.....24.10.....14.87

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

HIGHWAY BASIC HOURLY RATES	FRINGE BENEFIT PAYMENTS COMBINED
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CRAFTS: (continued)

Ballard, Caldwell, Calloway, Carlisle, Christian, Crittenden, Fulton, Graves, Hickman, Hopkins, Livingston, Lyon, Marshall, McCracken, Todd & Trigg Counties:

Millwrights:.....23.10.....14.09

Daviess, Hancock, Henderson, McLean, Muhlenberg, Ohio, Union & Webster Counties:

Millwrights:.....23.18.....13.66

Ballard County:

Painters:

Bridges and Dams28.81.....11.68

All Other Work24.51.....11.68

Spray, Blast, Steam, High and Hazardous (Including Lead Abatement) and All Epoxy – 1.00

Premium.

Edmonson County:

Painters:

Brush & Roller18.22.....9.37

Spray, Sandblast, Power Tools,

Waterblast & Steam Cleaning.....18.97.....9.37

Daviess, Hancock, Henderson, McLean, Ohio, Union & Webster Counties:

Painters:

Bridges, Locks & Dams:

GROUP 125.60.....10.05

GROUP 225.85.....10.05

GROUP 326.60.....10.05

GROUP 427.60.....10.05

All Other Work:

GROUP 124.45.....10.05

GROUP 224.70.....10.05

GROUP 325.45.....10.05

GROUP 426.45.....10.05

PAINTER CLASSIFICATIONS

GROUP 1 – Brush & Roller

GROUP 2 – Plasterers

GROUP 3 – Spray; Sandblast; Power Tools; Waterblast; Steamcleaning; Brush & Roller of Mastics, Creosotes, Kwinch Koate & Coal Tar Epoxy

GROUP 4 – Spray of Mastics, Creosotes, Kwinch Koate & Coal Tar Epoxy

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

HIGHWAY BASIC HOURLY RATES	FRINGE BENEFIT PAYMENTS COMBINED
Allen, Butler, Logan, Muhlenberg, Simpson, Todd & Warren Counties:	
Painters:	
<u>Bridges, Locks & Dams</u>	
Brush & Roller	22.05 7.90
Bridges, Locks & Dams	
Spray; Sandblast; Power Tools; Waterblast & Steam	
Cleaning	23.05 7.90
All Other Work	
Brush & Roller	17.05 7.90
All Other Work	
Spray; Sandblast; Power Tools; Waterblast & Steam	
Cleaning	18.05 7.90
All Other Work – High Time Pay	
Over 35 feet (up to 100 feet) - \$1.00 above base wage	
100 feet and over - \$2.00 above base wage	
During spray painting and sandblasting operations, pot tenders shall receive the same wage rates as the spray painter or nozzle operator	
Caldwell, Calloway, Carlisle, Christian, Crittenden, Fulton, Graves, Hickman, Hopkins, Livingston, Lyon, Marshall, McCracken & Trigg Counties:	
Painters:	
Bridges and Dams	24.75 9.55
All Other Work	18.50 9.55
Waterblasting units with 3500 PSI and above - \$.50 premium	
Spraypainting and all abrasive blasting - \$1.00 premium	
Work 40 ft. and above ground level - \$1.00 premium	
Allen, Butler, Edmonson, Simpson, Warren Counties:	
Plumber/Steamfitter	30.00 12.67
Ballard, Caldwell, Calloway, Carlisle, Christian, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken & Trigg Counties:	
Plumbers & Steamfitters	28.98 12.55
Davies, Hancock, Henderson, Hopkins, Logan, McLean, Muhlenberg, Ohio, Todd, Union & Webster Counties:	
Plumbers & Pipefitters	26.92 11.15
Welders - Receive rate for craft in which welding is incidental.	

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

LABORERS:

Ballard, Calloway, Carlisle, Fulton, Graves, Hickman, Livingston, Lyon, Marshall and McCracken Counties:

GROUP 1 - Aging & Curing of Concrete, Asbestos Abatement Worker, Asphalt Plant, Asphalt, Batch Truck Dump, Carpenter Tender, Cement Mason Tender, Cleaning of Machines, Concrete, Demolition, Dredging, Environmental -Nuclear Radiation, Toxic & Hazardous Waste - Level D, Flagperson, Grade Checker, Hand Digging & Hand Back Filling, Highway Marker Placer, Landscaping, Mesh Handler & Placer, Puddler, Railroad, Nip-Rap & Grouter, Right-of-Way, Sign, Guard Rail & Fence Installer, Signal Person, Sound Barrier Installer, Storm & Sanitary Sewer, Swamper, Truck Spotter & Dumper & Wrecking of Concrete Forms, General Cleanup.

BASE RATE.....19.43
FRINGE BENEFITS9.98

GROUP 2 - Batter Board Man (Sanitary & Storm Sewer), Brickmason Tender, Mortar Mixer Operator, Scaffold Builder, Burner & Welder, Bushhammer, Chain Saw Operator, Concrete Saw Operator, Deckhand Scow Man, Dry Cement Handler, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Level C, Forklift Operator for Masonary, Form Setter, Green Concrete Cutting, Hand Operated Grouter & Grinder Machine Operator, Jackhammer, Pavement Breaker, Paving Joint Machine, Pipelayer, Plastic Pipe Fusion, Power Driven Georgia Buggy & Wheelbarrow, Power Post Hole Digger, Precast Manhole Setter, Walk-Behind Tamper, Walk-Behind Trencher, Sand Blaster, Concrete Chipper, Surface Grinder, Vibrator Operator and Wagon Driller.

BASE RATE.....19.68
FRINGE BENEFITS9.98

GROUP 3 - Asphalt Luteman & Raker, Gunnite Nozzleman, Gunnite Operator & Mixer, Grout Pump Operator, Blaster, Side Rail Setter, Rail Paved Ditches, Screw Operator, Tunnel (Free Air), and Water Blaster .

BASE RATE.....19.73
FRINGE BENEFITS9.98

GROUP 4 - Caisson Worker (Free Air), Cement Finisher, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Levels A & B, Miner & Driller (Free Air), Tunnel Blaster and Tunnel Mucker (Free Air), Directional & Horizontal Boring, Air Track Drillers (All Types), Powderman & Blasters, Troxler & Concrete Tester if Laborer is Utilized.

BASE RATE.....20.33
FRINGE BENEFITS9.98

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

LABORERS:

Allen, Butler, Caldwell, Christian, Daviess, Edmonson, Hancock, Hopkins, Logan, McLean, Muhlenberg, Ohio Simpson, Todd, Trigg and Warren Counties;

GROUP 1 - Aging & Curing of Concrete, Asbestos Abatement Worker, Asphalt Plant, Asphalt, Batch Truck Dump, Carpenter Tender, Cement Mason Tender, Cleaning of Machines, Concrete, Demolition, Dredging, Environmental -Nuclear Radiation, Toxic & Hazardous Waste - Level D, Flagperson, Grade Checker, Hand Digging & Hand Back Filling, Highway Marker Placer, Landscaping, Mesh Handler & Placer, Puddler, Railroad, Nip-Rap & Grouter, Right-of-Way, Sign, Guard Rail & Fence Installer, Signal Person, Sound Barrier Installer, Storm & Sanitary Sewer, Swamper, Truck Spotter & Dumper & Wrecking of Concrete Forms, General Cleanup.

BASE RATE.....20.46
FRINGE BENEFITS8.95

GROUP 2 - Batter Board Man (Sanitary & Storm Sewer), BrickMason Tender, Mortar Mixer Operator, Scaffold Builder, Burner & Welder, Bushhammer, Chain Saw Operator, Concrete Saw Operator, Deckhand Scow Man, Dry Cement Handler, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Level C, Forklift Operator for Masonary, Form Setter, Green Concrete Cutting, Hand Operated Grouter & Grinder Machine Operator, Jackhammer, Pavement Breaker, Paving Joint Machine, Pipelayer, Plastic Pipe Fusion, Power Driven Georgia Buggy & Wheelbarrow, Power Post Hole Digger, Precast Manhole Setter, Walk-Behind Tamper, Walk-Behind Trencher, Sand Blaster, Concrete Chipper, Surface Grinder, Vibrator Operator and Wagon Driller.

BASE RATE.....20.71
FRINGE BENEFITS8.95

GROUP 3 - Asphalt Luteman & Raker, Gunnite Nozzleman, Gunnite Operator & Mixer, Grout Pump Operator, Blaster, Side Rail Setter, Rail Paved Ditches, Screw Operator, Tunnel (Free Air), and Water Blaster .

BASE RATE.....20.76
FRINGE BENEFITS8.95

GROUP 4 - Caisson Worker (Free Air), Cement Finisher, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Levels A & B, Miner & Driller (Free Air), Tunnel Blaster and Tunnel Mucker (Free Air), Directional & Horizontal Boring, Air Track Drillers (All Types), Powderman & Blasters, Troxler & Concrete Tester if Laborer is Utilized.

BASE RATE.....21.36
FRINGE BENEFITS8.95

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

LABORERS:

Crittenden, Henderson, Union and Webster Counties:

GROUP 1 - Aging & Curing of Concrete, Asbestos Abatement Worker, Asphalt Plant, Asphalt, Batch Truck Dump, Carpenter Tender, Cement Mason Tender, Cleaning of Machines, Concrete, Demolition, Dredging, Environmental -Nuclear Radiation, Toxic & Hazardous Waste - Level D, Flagperson, Grade Checker, Hand Digging & Hand Back Filling, Highway Marker Placer, Landscaping, Mesh Handler & Placer, Puddler, Railroad, Nip-Rap & Grouter, Right-of-Way, Sign, Guard Rail & Fence Installer, Signal Person, Sound Barrier Installer, Storm & Sanitary Sewer, Swamper, Truck Spotter & Dumper & Wrecking of Concrete Forms, General Cleanup.

BASE RATE.....19.51
FRINGE BENEFITS9.90

GROUP 2 - Batter Board Man (Sanitary & Storm Sewer), Brickmason Tender, Mortar Mixer Operator, Scaffold Builder, Burner & Welder, Bushhammer, Chain Saw Operator, Concrete Saw Operator, Deckhand Scow Man, Dry Cement Handler, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Level C, Forklift Operator for Masonary, Form Setter, Green Concrete Cutting, Hand Operated Grouter & Grinder Machine Operator, Jackhammer, Pavement Breaker, Paving Joint Machine, Pipelayer, Plastic Pipe Fusion, Power Driven Georgia Buggy & Wheelbarrow, Power Post Hole Digger, Precast Manhole Setter, Walk-Behind Tamper, Walk-Behind Trencher, Sand Blaster, Concrete Chipper, Surface Grinder, Vibrator Operator and Wagon Driller.

BASE RATE.....19.76
FRINGE BENEFITS9.90

GROUP 3 - Asphalt Luteman & Raker, Gunnite Nozzleman, Gunnite Operator & Mixer, Grout Pump Operator, Blaster, Side Rail Setter, Rail Paved Ditches, Screw Operator, Tunnel (Free Air), and Water Blaster .

BASE RATE.....19.81
FRINGE BENEFITS9.90

GROUP 4 - Caisson Worker (Free Air), Cement Finisher, Environmental - Nuclear, Radiation, Toxic & Hazardous Waste - Levels A & B, Miner & Driller (Free Air), Tunnel Blaster and Tunnel Mucker (Free Air), Directional & Horizontal Boring, Air Tack Drillers (All Types), Powderman & Blasters, Troxler & Concrete Tester if Laborer is Utilized.

BASE RATE.....20.41
FRINGE BENEFITS9.90

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

TEAMSTERS:

Truck Drivers:

Allen, Butler, Edmonson, Logan, Simpson & Warren Counties:
Greaser, Tire Changer.

BASE RATE19.04
FRINGE BENEFITS12.02

Truck Mechanic.

BASE RATE19.37
FRINGE BENEFITS12.02

Single Axle Dump, Flat Bed, all Terrain Vehicles when used to haul materials, Semi Trailer or Pole Trailer when used to pull building materials and equipment, Tandem Axle Dump, Driver of Distributors, Mixer all types.

BASE RATE19.44
FRINGE BENEFITS12.02

Winch and A-frame when used in transporting materials, Ross Carrier, Fork Lift when used to transport building materials, Driver on Pavement Breaker.

BASE RATE19.45
FRINGE BENEFITS12.02

Euclid and other Heavy Earth Moving Equipment, Low Boy, Articulator Cat, Five Axle Vehicle.

BASE RATE19.50
FRINGE BENEFITS12.02

Ballard, Calloway, Caldwell, Carlisle, Christian, Crittenden, Fulton, Graves, Hickman, Livingston, Lyon, Marshall, McCracken, Todd & Trigg Counties:
Greaser, Tire Changer.

BASE RATE23.89
FRINGE BENEFITS4.15

Truck Mechanic.

BASE RATE24.12
FRINGE BENEFITS4.15

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

TEAMSTERS: (continue)

Single Axle Dump, Flat Bed, all Terrain Vehicles when used to haul materials, Semi Trailer or Pole Trailer when used to pull building materials and equipment, Tandem Axle Dump, Driver of Distributor, Mixer all types.

BASE RATE24.19
FRINGE BENEFITS4.15

Euclid, other Heavy Earth Moving Equipment, Low Boy, Articulator Cat, Five Axle Vehicle, Winch & A-Frame when used in transporting materials, Ross Carrier.

BASE RATE24.20
FRINGE BENEFITS4.15

Daviess, Hancock, Henderson, Hopkins, McLean, Muhlenberg, Ohio, Union & Webster Counties: Greaser, Tire Changer.

BASE RATE19.23
FRINGE BENEFITS9.20

Truck Mechanic.

BASE RATE19.46
FRINGE BENEFITS9.20

Single Axle Dump, Flat Bed, all Terrain Vehicle when used to haul materials, Semi Trailer or Pole Trailer when used to pull building materials and equipment, Tandem Axle Dump, Driver of Distributors, Mixer all types.

BASE RATE19.53
FRINGE BENEFITS9.20

Euclid and other Heavy Earth Moving Equipment, Low Boy, Articulator Cat, Five Axle Vehicle, Winch & A-Frame when used in transporting materials, Ross Carrier, Fork Lift when used to transport building materials, Driver on Pavement Breaker.

BASE RATE19.54
FRINGE BENEFITS9.20

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

OPERATING ENGINEERS:

A-frame Winch Truck, Auto Patrol, Backfiller, Batcher Plant, Bituminous Paver, Bituminous Transfer Machine, Boom Cat, Bulldozer, Mechanic, Cableway, Carry-All Scoop, Carry Deck Crane, Central Compressor Plant, Clamshell, Concrete Mixer (21 cu. ft. or over), Concrete Paver, Truck Mounted Concrete Pump, Core Drill, Crane, Crusher Plant, Derrick, Derrick Boat, Ditching and Trenching Machine, Dragline, Dredge Operator, Dredge Engineer, Elevating Grader and Loaders, Grade-All, Gurries, Heavy Equipment Robotics Operator/Mechanic, High Lift, Hoe-Type Machine, Hoist (two or more drums), Hoisting Engine (two or more drums), Horizontal Directional Drill Operator, Hydrocrane, Hyster, KeCal Loader, LeTourneau, Locomotive, Mechanic; Mechanically Operated Laser Screed, Mechanic Welder, Mucking Machine, Motor Scraper, Orangepeel Bucket, Piledriver, Power Blade, Pumpcrete, Push Dozer, Rock Spreader attached to equipment, Rotary Drill, Roller (bituminous), Scarifier, Scoopmobile, Shovel, Side Boom, Subgrader, Tailboom, Telescoping type Forklift, Tow or Push boat, Tower Crane (French, German and other types), Tractor Shovel, Truck Crane, Tunnel Mining Machines, including Moles, Shields or similar types of Tunnel Mining Equipment.

BASE RATE23.60
FRINGE BENEFITS12.40

Air Compressor (over 900 cu. ft. per min.), Bituminous Mixer, Boom Type Tamping Machine, Bull Float, Concrete Mixer (under 21 cu. ft.), Dredge Engineer, Electric Vibrator, Compactor/Self-Propelled Compactor, Elevator (one drum or buck hoist), Elevator (when used to hoist building material), Finish Machine, Firemen & Hoist (one drum), Flexplane, Forklift (regardless of lift height), Form Grader, Joint Sealing Machine, Outboard Motor Boat, Power Sweeper (riding type), Roller (rock), Ross Carrier, Skid Mounted or Trailer Mounted Concrete Pump, Skid Steer Machine with all attachments, Switchman or Brakeman, Throttle Valve Person, Tractair and Road Widening Trencher, Tractor (50 H.P. or over), Truck Crane Oiler, Tugger, Welding Machine, Well Points, and Whirley Oiler.

BASE RATE21.18
FRINGE BENEFITS12.40

All off road material handling equipment, including Articulating Dump Trucks, Greaser on grease facilities servicing heavy equipment.

BASE RATE21.56
FRINGE BENEFITS12.40

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

OPERATING ENGINEERS: (continued)

Bituminous Distributor, Burlap and Curing Machine, Cement Gun, Concrete Saw, Conveyor, Deckhand Oiler, Grout Pump, Hydraulic Post Driver, Hydro Seeder, Mud Jack, Oiler, Paving Joint Machine, Power Form handling equipment, Pump, Roller (Earth), Steerman, Tamping Machine, Tractor (under 50 H.P.) and Vibrator.

BASE RATE	20.92
FRINGE BENEFITS	12.40

Cranes - with booms 150 ft. and over (including jib), and where the length of the Boom in combination with the length of the piling equals or exceeds 150 ft. - \$1.00 above Group 1 rate.

Employees assigned to work below ground level are to be paid 10% above basic wage rate. This does not apply to open cut work.

Fringe benefit amounts are applicable for all hours worked except when otherwise noted.

These rates are listed pursuant to the Kentucky Determination No. CR-06-IHWY dated July 10, 2007 and/or Federal Decision No. KY20080025 dated February 8, 2008, modification #0 dated February 8, 2008, modification #1 dated April 4, 2008, modification #2 dated June 6, 2008, modification #3 dated July 4, 2008, modification #4 dated July 25, 2008, modification #5 dated August 1, 2008, modification #6 dated August 15, 2008, modification #7 dated September 5, 2008 and modification #8 dated October 3, 2008.

**TRANSPORTATION CABINET
DIVISION OF CONSTRUCTION PROCUREMENT
COMPLIANCE SECTION
PROJECT WAGE RATES**

No laborer, workman or mechanic shall be paid at a rate less than that of a Journeyman except those classified as bona fide apprentices.

Apprentices or trainees shall be permitted to work as such subject to Administrative Regulations adopted by the Commissioner of Workplace Standards. Copies of these regulations will be furnished upon request from any interested person.

Before using apprentices on the job the contractor shall present to the Contracting Officer written evidence of registration of such employees in a program of a State apprenticeship and training agency approved and recognized by the U. S. Bureau of Apprenticeship and Training. In the absence of such a State agency, the contractor shall submit evidence of approval and registration by the U. S. Bureau of Apprenticeship and Training.

The contractor shall submit to the Contracting Officer, written evidence of the established apprenticeship-journeyman ratios and wage rates in the project area, which will be the basis for establishing such ratios and rates for the project under the applicable contract provisions.

TO: EMPLOYERS/EMPLOYEES

PREVAILING WAGE SCHEDULE:

The wages indicated on this wage schedule are the least permitted to be paid for the occupations indicated. When an employee works in more than one classification, the employer must record the number of hours worked in each classification at the prescribed hourly base rate.

OVERTIME:

Overtime is to be paid after an employee works eight (8) hours a day or forty (40) hours a week, whichever gives the employee the greater wages. At least time and one-half the base rate is required for all overtime. A laborer, workman or mechanic and an employer may enter into a written agreement or a collective bargaining agreement to work more than eight (8) hours a calendar day but not more than ten (10) hours a calendar day for the straight time hourly rate.

Wage violations or questions should be directed to the designated Engineer or the undersigned.

Steve Waddle, Director
Division of Construction Procurement
Frankfort, Kentucky 40622

**NOTICE OF REQUIREMENT FOR AFFIRMATIVE ACTION
TO ENSURE EQUAL EMPLOYMENT OPPORTUNITY
(Executive Order 11246)**

1. The Offeror's or Bidder's attention is called to the "Equal Opportunity Clause" and the "Standard Federal Equal Employment Specifications" set forth herein.
2. The goals and timetables for minority and female participation, expressed in percentage terms for the Contractor's aggregate work force in each trade on all construction work in the covered area, are as follows:

GOALS FOR MINORITY PARTICIPATION IN EACH TRADE	GOALS FOR FEMALE PARTICIPATION IN EACH TRADE
18.2%	6.9%

These goals are applicable to all the Contractor's construction work (whether or not it is Federal or federally-assisted) performed in the covered area. If the contractor performs construction work in a geographical area located outside of the covered area, it shall apply the goals established for such geographical area where the work is actually performed. With regard to this second area, the contractor also is subject to the goals for both its federally involved and non-federally involved construction.

The Contractor's compliance with the Executive Order and the regulations in CFR Part 60-4 shall be based on its implementation of the Equal Opportunity Clause, specific affirmative action obligations required by the specifications set forth in 41 CFR 60-4, 3(a), and its efforts to meet the goals. The hours of minority and female employment and training must be substantially uniform throughout the length of the contract, and in each trade, and the contractor shall make a good faith effort to employ minorities and women evenly on each of its projects. The transfer of minority or female employees or trainees from Contractor to Contractor or from project to project for the sole purpose of meeting the Contractor's goals shall be a violation of the contract, the Executive Order and the regulations in 41 CFR Part 60-4. Compliance with the goals will be measured against the total work hours performed.

3. The Contractor shall provide written notification to the Director of the Office of Federal Contract Compliance Programs within ten (10) working days of award of any construction subcontract in excess of \$10,000.00 at any tier for construction work under the contract resulting from this solicitation. The notification shall list the name, address and telephone number of the subcontractor; employer identification number of the subcontractor; estimated dollar amount of the subcontract; estimated starting and completion dates of the subcontract; and the geographical area in which the subcontract is to be performed. The notification shall be mailed to:

**Evelyn Teague, Regional Director
Office of Federal Contract Compliance Programs
61 Forsyth Street, SW, Suite 7B75
Atlanta, Georgia 30303-8609**

4. As used in this Notice, and in the contract resulting from this solicitation, the "**covered area**" is Christian County.

PART IV
INSURANCE

INSURANCE

The Contractor shall carry the following insurance in addition to the insurance required by law:

1. Contractor's Public Liability Insurance not less than \$100,000.00 for damages arising out of bodily injuries to or death to one person. Not less than \$300,000.00 for damages arising out of bodily injuries to or death to two or more persons.
2. Contractor's Property Damages Liability Insurance. Not less than \$100,000.00 for all damages arising out of injury or destruction of property in any one accident. Not less than \$300,000.00 for all damages during the policy period.
3. Contractor's Protective Public Liability and Property Damage Insurance. The contractor shall furnish evidence with respect to operations performed for him by subcontractors that he carries in his own behalf for the above stipulated amounts.
4. The insurance required above must be evidenced by a Certificate of Insurance and this Certificate of Insurance must contain one of the following statements:
 - a. "policy contains no deductible clauses."
 - b. "policy contains _____ (amount) deductible property damage clause but company will pay claim and collect the deductible from the insured."
5. WORKMEN'S COMPENSATION INSURANCE. The contractor shall furnish evidence of coverage of all his employees or give evidence of self-insurance by submitting a copy of a certificate issued by the Workmen's Compensation Board.

PART V
BID ITEMS

CONTRACT ID: 081030
COUNTY: CHRISTIAN
PROPOSAL: DPR 0171(004)

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LINE NO	ITEM	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT PRICE	AMOUNT
SECTION 0001 ROADWAY						
0010	00001	DGA BASE	274.500	TON		
0020	00100	ASPHALT SEAL AGGREGATE	5.410	TON		
0030	00291	EMULSIFIED ASPHALT RS-2	0.520	TON		
0040	02351	GUARDRAIL-STEEL W BEAM-S FACE	605.000	LF		
0050	02353	INSTALL GUARDRAIL-STEEL W BM-S FACE	430.000	LF		
0060	02360	GUARDRAIL TERMINAL SECTION NO 1	2.000	EACH		
0070	02367	GUARDRAIL END TREATMENT TYPE 1	2.000	EACH		
0080	02369	GUARDRAIL END TREATMENT TYPE 2A	2.000	EACH		
0090	02650	MAINTAIN & CONTROL TRAFFIC	(1.00)	LS		
0100	02671	PORTABLE CHANGEABLE MESSAGE SIGN	2.000	EACH		
0110	02775	ARROW PANEL	2.000	EACH		
0120	05950	EROSION CONTROL BLANKET	1,637.000	SQYD		
0130	21533EN	EMBANKMENT	60.000	CUYD		
0140	21554EN	EXCAVATION	19.000	CUYD		
SECTION 0002 BRIDGE						
0150	06490	CLASS A CONCRETE FOR SIGNS	31.200	CUYD		
0160	06491	STEEL REINFORCEMENT FOR SIGNS	2,582.000	LB		
0170	20419ED	ROADWAY CROSS SECTION	1.000	EACH		
0180	21055ND	OSS GALVANIZED STEEL 100 FT	1.000	EACH		
SECTION 0003 SIGNING						
0190	06400	GMSS GALV STEEL TYPE A	1,722.600	LB		

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LINE NO	ITEM	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT PRICE	AMOUNT
0200	06490	CLASS A CONCRETE FOR SIGNS	4.360	CUYD		
0210	20419ED	ROADWAY CROSS SECTION	2.000	EACH		
SECTION 0004 HITS						
0220	02187	SITE PREPARATION	4.000	EACH		
0230	02562	SIGNS	200.000	SQFT		
0240	03381	PVC PIPE-2 IN	5,675.000	LF		
0250	04742	POLE BASE-HIGH MAST	2.000	EACH		
0260	04795	CONDUIT-2 IN	520.000	LF		
0270	04820	TRENCHING AND BACKFILLING	2,832.500	LF		
0280	04834	WIRE-NO. 6	2,400.000	LF		
0290	04835	WIRE-NO. 4	6,126.000	LF		
0300	04836	WIRE-NO. 2	4,870.000	LF		
0310	04899	ELECTRICAL SERVICE	4.000	EACH		
0320	20391NS835	JUNCTION BOX TYPE A	8.000	EACH		
0330	20392NS835	JUNCTION BOX TYPE C	4.000	EACH		
0340	21058ND	WINCH LOWERING TOOL	1.000	EACH		
0350	21065ND	MODEL 334 ENCLOSURE	3.000	EACH		
0360	21066ND	MODEL 336 ENCLOSURE	5.000	EACH		
0370	21069ND	SURGE DEVICE 120 VOLT	8.000	EACH		
0380	21071ND	DATA SURGE DEVICE	13.000	EACH		
0390	21076ND	FIBER TERMINATION RACK	6.000	EACH		

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LINE NO	ITEM	DESCRIPTION	APPROXIMATE QUANTITY	UNIT	UNIT PRICE	AMOUNT
0400	21077ED	FIBER OPTIC CABLE	1,325.000	LF		
0410	21079ND	TRANSFORMER 480/120	1.000	EACH		
0420	21117ND	VARIABLE MESSAGE SIGN-DYNAMIC	1.000	EACH		
0430	21458ND	FIBER TRANSCEIVER SIGN	6.000	EACH		
0440	21487ND	VIDEO MONITOR	1.000	EACH		
0450	22403NN	WEB CAMERA ASSEMBLY	10.000	EACH		
0460	22407NN	POLE BASE-40 FT POLE	2.000	EACH		
0470	22408NN	VARIABLE MESSAGE SIGN-DYNAMIC SIDE MOUNT	2.000	EACH		
0480	22409NN	STEEL STRAIN POLE-40 FT	2.000	EACH		
0490	23022NN	INSTALL HIGH MAST CONTROL CABLE	1.000	EACH		
0500	23023NN	RETROFIT HIGH MAST LOWERING DEVICE	1.000	EACH		
0510	23149NN	CCTV CONTROL CABLE	200.000	LF		
0520	23150NN	COMMUNICATION CABLE	680.000	LF		
0530	23151NN	POLE WITH LOWERING DEVICE	2.000	EACH		
SECTION 0005		DEMOBILIZATION				
0540	02569	DEMOBILIZATION		LUMP		
		TOTAL BID				