Chapter B CONTRACT DOCUMENTS

A contract package consists of the following:

(a) Tender forms
- Contract Tender Items List
- Instructions for Tenderers
- Conflict of Interest
- Schedule of Provisions, Plans, Standard Drawings and Specifications
- General Conditions

Fairness is a Two-way Street
- Tax Compliance Declaration

(b) Section A – Special Provisions
(c) Section B – Fair Wage Program
(d) Section C – Liquidated Damages
(e) Contract Drawings
(f) Quantity Sheets

In this chapter, contract documents, their contents, preparation and the forms used are described.

B.1 Contract Preparation System (CPS)

All components of the contract package, except for the drawings are prepared by an ATMS designer using the Contract Preparation System (CPS). The Contract Preparation System is custom computer software developed by the Ministry to standardize and automate contract preparation process.

ATMS Designers must obtain access to the system by following a registration procedure set up by the Ministry. The information about the CPS and the access procedure may be found on the Ministry's web site www.mto.gov.on.ca.

Upon completion of the registration process, the user is provided with "username" and "password" which enables access to the system.

B.2 Master ATMS Tender Item List

The ATMS tender items listed in this chapter are accessible through the CPS. CPS contains the item master list for all disciplines and includes the ATMS tender items.

The CPS lists the tender items (680 series code) used in the Ministry's ATMS contracts. The measurement and basis of payment for these tender items are described within the Special Provision for each item. CPS also maintains a list tender items and their titles less frequently used (non-standard). These items are preceded by code numbers starting from 9999-0001.

All ATMS contracts advertised by the Ministry use the principle of Plan Quantity Payment (PQP) which means, that payment is made according to the quantities shown in the contract drawings. The purpose of PQP is to eliminate field measurements during and after construction. The following describes the headings used in the list of ATMS tender items.

- ITEM CODE. This is used for CPS in referencing items. The first four digits indicate the OPSS number where the item is described, or if no OPSS exists as it is the case for many of the 680 to 699 series items, the Special Provision number. The last four digits indicate the item reference number. SPEC Nos.

- TITLE. The tender items listed are the most commonly used items in ATMS contracts. Only those items listed can be selected in CPS by an ATMS designer. If non-standard tender items are required, they must be requested through the Contract Review Officer designated to the project.

- UNIT. The unit shown for each tender item is used as the measurement for payment. When "Each" is specified, the items are counted. When "m" (metre) is specified, the items are measured or calculated on plans. When "Lump Sum" is specified, the items are portions of a contract for which payment is made at a single tendered price, i.e., one tender item per lump sum item. "(P)" stands for Plan Quantity Payment (PQP).

  The computed quantities on tender documents must be accurate to avoid discrepancies with field quantities. Rounding linear measurements (unit "m") to the nearest whole number is sufficiently accurate.

- REFERENCES/SP's, and construction detail drawing that are associated with the item.

The following table contains a master list of ATMS tender items. Some of the items have a specification code lower than 068X. These items are standard electrical items that include additional requirements for ATMS documented in Special Provisions 682SXX as referenced against the item. There are other standard electrical items used in contracts with ATMS work without any additional requirements. A complete list of these items is provided in this chapter in section B.5. All standard electrical items are included in the Electrical Engineering Manual Volume 3.

Table B-1. Master ATMS Tender Item List.

Item Code	Tender Item	Unit of Measure	References	
			SSP	Drawings
0599-0010	Bollards	each (P)	599S27	MTOD 2940.210
0603-0027	Flexible Ducts By Subsurface Installation	m (P)	682S07	
0603-0029	Flexible Ducts By Subsurface Installation For Magnetic Detectors	m (P)	682S33	MTOD 2902.426 MTOD 2902.427
0603-0030	Rigid Ducts Concrete Encased For Magnetic Detectors	m (P)	682S33	MTOD 2902.426 MTOD 2902.427
0603-0045	Rigid Ducts Direct Buried	m (P)	682S07	MTOD 2930.020 MTOD 2920.030 MTOD 2920.010 MTOD 2930.060
0603-0046	Rigid Ducts Direct Buried (Temporary)	m (P)	682S07	
0603-0081	Surface Mounted Duct Systems	m (P)	682S08	MTOD 2930.050
0603-0082	Surface Mounted Duct Systems (Temporary)	m (P)	682S08	
0604-0050	Extra Low Voltage Cables, In Ducts	m (P)	682S09	
0604-0051	Extra Low Voltage Cables, In Ducts (Temporary)	m (P)	682S09	
0604-0052	Extra Low Voltage Cables For Magnetic Detectors, In Ducts	m (P)	682S32	0604-0052
0604-0053	Extra Low Voltage Cables For Magnetic Detectors, In Ducts (Temporary)	m (P)	682S32	0604-0053
0615-0030	Concrete Poles, Direct Buried In Earth	m (P)	682S13	MTOD 2960.010
0616-0020	Concrete Footings In Earth	each (P)	682S25	MTOD 2940.010
0616-0040	Concrete Pads	each (P)	682S14	MTOD 2940.010 MTOD 2920.020 MTOD 2920.021 MTOD 2920.022

Item Code	Tender Item	Unit of Measure	References	
			SSP	Drawings
0623-0020	ATMS Loop Detectors	each (P)	682S19	MTOD 2950.010 MTOD 2950.110 MTOD 2950.020 MTOD 2950.021 MTOD 2950.030 MTOD 2950.031 MTOD 2950.011 MTOD 2950.115 MTOD 2950.210 MTOD 2950.012 MTOD 2950.013
0623-0021	ATMS Loop Detectors (Temporary)	each (P)	682S19	MTOD 2950.010 MTOD 2950.110 MTOD 2950.020 MTOD 2950.021 MTOD 2950.030 MTOD 2950.031 MTOD 2950.011 MTOD 2950.115 MTOD 2950.210 MTOD 2950.012 MTOD 2950.013 MTOD 2950.014
0681-0010	Maintenance And Warranty For Advanced Traffic Management System Work	lump sum	681F25	
0681-0020	Training For Advanced Traffic Management System Work	lump sum	681F15	
0681-0030	Spare Components For Advanced Traffic Management System Work	lump sum	681F17	
0681-0040	System Integration Testing For Advanced Traffic Management System Work	lump sum	681F19	
0681-0050	Ground Deployment Of Portable Variable Message Signs	each (P)	681F32	MTOD 2980.010
0681-0055	Fixed Deployment Of Variable Message Signs	each (P)	681S33	
0681-0060	Maintenance And Warranty For Portable Variable Message Signs	lump sum	681F34	
0682-0009	ATMS Field Equipment Cabinet Maintenance Sites	lump sum	682S01	MTOD 2940.220 MTOD 2940.221
0682-0030	Extra Low Voltage Cables In Sawcut Slots	m	682S09	

Item Code	Tender Item	Unit of Measure	References	
			SSP	Drawings
0682-0045	Uninterruptible Power Supply Units	each (P)	682S28	
0682-0050	Base Mounted Communication Pedestals	each (P)	682S15	MTOD 2940.120 MTOD 2940.115 MTOD 2940.110
0682-0055	Controller Cabinets, Pole Mounted	each (P)	682S27	
0682-0060	Controller Cabinets	each (P)	682S16	MTOD 2940.020 MTOD 2920.015 MTOD 2920.016 MTOD 2940.030
0682-0061	Controllers	each (P)	682S17	
0682-0063	Non-Intrusive Traffic Sensors (Microwave)	each (P)	682S26	MTOD 2950.510
0682-0064	Magnetic Detectors	each (P)	682S29	
0682-0065	Loop Vehicle Detector Sensor Units	each (P)	682S18	
0682-0066	Magnetic Detector Cards	each (P)	682S31	MTOD 2902.420 MTOD 2902.421 MTOD 2902.422
0682-0070	Test Existing Loop Detectors	each (P)	682S20	
0682-0071	Sawcut Slot for Extra Low Voltage Cables	m (P)	682S09	
0682-0080	Removal Of Advanced Traffic Management System Equipment	lump sum	682F22	
0682-0091	Inner Chambers	m (P)	682S23	
0682-0100	Concrete Pole, Direct Buried In Earth With Camera Raising And Lowering System	each (P)	682S30	MTOD 2960.010
0683-0009	Splice Enclosures For Fibre Optic Cables	each (P)	683S02	MTOD 2940.110
0683-0010	Fibre Optic Communication Cables, In Ducts	m (P)	683S01	MTOD 2930.010
0683-0012	Data Interface Cables	lump sum	683S03	
0683-0013	Fibre Optic Communication Cables, In Ducts (Temporary)	m (P)	683S01	MTOD 2930.010

Item Code	Tender Item	Unit of Measure	References	
			SSP	Drawings
0683-0014	Fibre Optic Communication Cables, Aerial On Messenger Cable	m (P)	683S01	MTOD 2910.010 MTOD 2910.020 MTOD 2910.025
0683-0015	Fibre Optic Communication Cables, Aerial On Messenger Cable (Temporary)	m (P)	683S01	MTOD 2910.010 MTOD 2910.020 MTOD 2910.025
0683-0020	Video Transmitters And Receivers	each (P)	683S04	
0683-0023	Video System Line Up And Test	each (P)	683S07	
0683-0030	Drop/Insert Nodes Channel Ports	each (P)	683S19	
0683-0034	Port Sharing Devices	each (P)	683S10	
0683-0035	Data System Line-up And Test	lump sum	683S11	
0683-0036	Fibre Optic Modems	each (P)	683S09	
0683-0037	Fibre Optic Ethernet Modems	Each (P)	683S26	
0683-0046	Leased Line Modems	each (P)	683S21	MTOD 2940.015
0683-0051	Wireless Ethernet Bridges	each (P)	683S22	
0683-0055	Digital Video Encoders and Decoders	each pair (P)	683S23	
0683-0060	Port Servers	each (P)	683S24	
0683-0065	Ethernet Switches	each (P)	683S25	
0684-0011	Outdoor Closed Circuit Television Cameras	each (P)	684S01	MTOD 2960.110 MTOD 2960.210
0684-0012	Outdoor Pan / Tilt Units	each (P)	684S03	MTOD 2960.111 MTOD 2960.010
0684-0050	Closed Circuit Television Video Monitors	each (P)	684S07	
0684-0055	Dome Cameras	each (P)	684S10	
0685-0010	Variable Message Signs	each (P)	685S01, 168S32	MTOD 2970.110 MTOD 2970.120 MTOD 2970.310
0685-0016	Portable Variable Message Signs, Trailer Mounted	each (P)	685S06, 168S32	MTOD 2980.010 MTOD 2970.311

Item Code	Tender Item	Unit of Measure	References	
			SSP	Drawings
0685-0021	Fixed Support Mountable Variable Message Signs	each (P)	685S07, 168S32	MTOD 2970.311
0687-9010	Rack Assemblies	each (P)	687S01	
0699-6142	Power Supply Cabinets	each (P)	682S12	MTOD 2940.310 MTOD 2940.320

B.3 CPS - Main Menu

One of the items that appear in the main menu of CPS is the Work Project. Clicking on this button allows the user to create a work project or edit an existing one. If the user chooses to create a new work project file and enters the new project W.P number, clicking on the 'edit' button displays the 'Work Project' menu. One of the items in this menu is the 'Tender Item List'.

B.3.1 Tender Item List

This form is used to list Tender items and their quantities, including pertinent construction specifications and special provisions that describe the proposed work. This form is the very first document to be filled out when completing work project documentation after the drawings are done. The ATMS designer selects from the Master Item list the ATMS tender items relevant to the project under design to create tender item list. The CPS lists the specifications and special provisions automatically. The designer must review the specification list and modify, as required.

Tender items are numbered automatically. The quantities in the tender item list are filled in automatically after the quantity sheets are completed. The columns provided for unit price and total should be left blank.

B.3.2 Form of Tender

The next item to be completed within the Work Project menu is the 'Form of Tender'. Its functions are to: (a) give the information to produce the tender on which the Contractor's bid price is based, and (b) provide information for the Estimating Office to estimate future jobs. The submenu consists of the following:

B.3.2.1 Proposed Work

Allows users to add contract information related to the work project. The information included here will appear in the Proposed Work report. A composite work project will list all of the components of the project in the Included WPs field.

B.3.2.2 Summary

This form allows users to add cost information to the work project. The fields that are white allow editing. The fields that are grey represent summary values. The summary values might be subtotals of the fields on the Summary tab or they might be totals from other tabs.

B.3.2.3 Services

The following discusses when services (sundry) and acquisition/construction of physical assets may be used on a project. These services may be used when a specific type of work is to be:

- ♦ Carried out by MTO forces due to work indeterminacy
- ♦ Negotiated with and carried out by the Contractor
- ♦ Carried out by forces other than MTO or Contractor, such as utility companies.

The use of tender item "Rigid Ducts by Sub-surface Installation" should be discussed with the project manager as to whether it should be included on the tender form or on the acquisition/construction of physical assets form. The presence of unforeseen factors (such as abandoned ducts under the pavement that block the auguring procedure for rigid ducts installation) makes it difficult for the Contractor to bid for this item if it is included on the tender form; however, if the item is included on the acquisition/construction of physical assets form, the Contractor would be able to receive payment based on equipment, labour and overhead costs.

B.3.2.3.1 Form "Services (Sundry) (Code 4)"

The form "Services (Sundry) (Code 4)", as shown in Figure B-1, is provided by the Contract Preparation System (CPS). The ATMS designer, in consultation with the Ministry, determines which parts of the electrical work will be done under sundry. Therefore, funds are set aside for the work intended to be performed by the Ministry forces. Where all or part of the ATMS work is to be done under services, the work is indicated on the services form as a lump sum entry. Details of materials are required only where the breakdown of components would be beneficial for cost assessment. The cost column "Total" is completed by the ATMS designer. The "Services (Sundry) (Code 4)" form shows the following headings:

- GROUP WP
- CONTRACT
- DISTRICT
- HIGHWAY
- DATE

These headings are automatically filled with appropriate information for the particular project when that project is opened from the CPS. Columns under headings "Description", "Unit" and "Total" are completed as shown in Figure B-1. See "CPS User's Guide" under 'Prepare Services, Materials, and Acquisition, Recoverable.

B.3.2.3.2 Form "Acquisition/Construction of Physical Assets (Code 6)"

The form "Acquisition/Construction of Physical Assets (Code 6)", as shown in Figure B-2, is provided by CPS. "Force Account and Contingencies" are work done on a negotiated basis with the Contractor and do not require "Unit Price" and "Total" entry until an acceptable amount has been agreed upon between the Ministry and the Contractor. A percent of tender for "Miscellaneous Force Account and Contingencies" is required to be entered by the Estimating Office.

"Utilities and Work by Others" requires entry of work done by others such as installation of electrical work by a utility company. The ATMS designer consults the utility company or the district utility coordinator as to the availability and cost of corresponding utility works which are entered by the ATMS designer.

When applying for a service layout from the electrical utility, ATMS designers should remember that service layout fees and agreements are valid only for 365 days starting from the date the agreement is prepared. If the project is not done within this time limit, the project is removed from Hydro's file. In this situation, to re-apply means to set up another meeting with Hydro to discuss the project and re-estimate. This procedure takes considerable amount of time. In the cases when the designer estimates that the project will not be accomplished before the set time period, he/she should request Hydro to re-estimate of the project. Or if possible, if the designer is confident in the estimated project timing, he/she should indicate it in the service layout application with a note stating not to discard the file before a certain date set up by the designer.

The "Acquisition/Construction of Physical Assets (Code 6)" form shows the following headings:

- GROUP WP
- CONTRACT
- DISTRICT
- HIGHWAY
- DATE

These headings are automatically filled with appropriate information for the particular project when that project is opened from the CPS. Columns under headings "Utilities and Work by Others", "Utility Order", "Work Order" and "Total" are completed as shown in Figure B-2. See "CPS User's Guide" under 'Prepare Services, Materials, and Acquisition, Recoverable'.

B.3.2.4 Recoverable (To Ministry/Province)

This form requires the listing of such agencies which by agreement (legal agreement, work order, letter of commitment) are sharing costs with the Ministry and will reimburse the Ministry for their part of Acquisition/Construction of Physical Assets, Engineering and Engineering Expenses, etc.

The "Recoverable (To Ministry/Province)" form shows the following headings:

- GROUP WP
- CONTRACT
- DISTRICT
- HIGHWAY
- DATE

These headings are automatically filled with appropriate information for the particular project when that project is opened from the CPS. Other information such as description, recoverable from, type of agreement and date are filled in as shown. The rest are filled in by the Head Office Estimating Section.

B.3.2.5 Supplies by MTO to Contractors

This form specifies materials to be supplied to the Contractor by the Ministry. Such materials include items that are always purchased by the Ministry such as locks or materials provided from the Ministry's spare inventory when timing of installation does not allow enough time for procurement by the Contractor. These materials may include short sections of fibre optic cables, controller cabinets and others.

B.3.3 Reports

From the 'Work Project' menu, clicking on the button called 'Reports' displays 'Tender Item List'. When executed, this button opens the Microsoft Word file to give the designer an opportunity to edit the list of tender items and the Schedule of Provisions, Plans, Standard Drawings, specifications and General Conditions which is automatically filled in by CPS.

B.3.4 Example Reports

Examples of tender forms are shown as forms B-1 to B-4.

Services (4)
(Sundry)

Group WP	Contract	District	Highway	Date
X	20XX-20XX	X	X	

Description	Unit	Quantity	Unit Price	Total
Advance installation of fibre cable between X and Y	Lump Sum			

Sub Total:
Miscellaneous Services and Supplies:
Total Services:

10/31/05 Page 1 of 1

Form B-1 Example of "Services (Sundry) (Code 4)".

Acquisition/Construction
of Physical Assets (6)

Group WP	WP Type	Contract Number	District	Highway
X		20XX-20XX	X	X

Force Acct and Contingencies	Unit	Quantity	Unit Price	Total
Cleaning of Existing Ducts	m	4,500		

Misc. Force Acc and Contingencies 0.0% of Tender:

Total Force Acc and Contingencies:

Utilities and Work by Others	Utility Order	Work Order	Total
Provision of new power service for PVMS			$ 450.00
Supply and installation of two wood poles by Bell Canada			$ 1950.00
		Total:	$2,400.00

10/31/05 Page 1 of 1

Form B-2 Example of "Acquisition/Construction of Physical Assets (Code 6)"

Recoverable

Group WP	WP Type	Contract Number	District	Highway
Example	ELEC	20XX-20XX	Toronto	401

Description	Recoverable from	Agreement Type/Date Total	ICQ/Const of Physical Assets (*)	Other (**)
Recoverable to Ministry:				
Supply of one (1) VMS	City of Axe	Legal		
			Total:	$0.00

Page 1 of 1

Form B-3 Example of “Recoverables".

Supplies by MTO to Contractors (5)

Group WP	WP Type	Contract No.	District	Highway
607-00-00	ATMS		Toronto	QEW

(A) The MTO supplies the following materials F.O.B. haulage vehicle at a point within the limits of the contract which shall be as requested by the Contractor but subject to the approval of the engineer:

Description	Supply Point	U.O.M.	Quantity	Unit Price	Total
				Sub Total:	**$0.00**

(B) The MTO supplies the following materials as indicated below:

Description	Supply Point	U.O.M.	Quantity	Unit Price	Total
Padlocks for Base Mounted Communication Pedestals	MTO Winona Yard 1200 South service Road Winona, Ontario L8E 5R1	each	16	50	800
				Sub Total:	**$800.00**
				Grand Total:	**$800.00**

Form B-4 Example of "Supplies by MTO to Contractors".

B.4 Special Provisions

Generally, the work of a Contract is controlled by the General Conditions of Contract.

This section provides a basis for the use of the Ministry Standard and Non-Standard Special Provisions which either modify/supplement the Ontario Provincial Standard Specifications or provide stand-alone specifications for the ATMS tender items.

The Advanced Traffic Management Section (ATMS) is responsible for the technical aspects of this section of the manual. This section provides background, application instruction, and contract submission requirements for Standard Special Provisions and Non-Standard Special Provisions.

The term "Special Provision" as defined by the General Conditions means special directions containing requirements peculiar to the work not adequately covered by the Standard or Supplemental Specifications. In preparing contract documents, the designer considers Special Provisions from two categories: Standard Special Provisions and Non-Standard Special Provisions.

Most ATMS work projects contain requirements not covered by the Standard Specifications. To cover these situations, a Special Provision is inserted in the Contract. The functions of a Special Provisions can be divided into the following areas:

- Information to Contractors (operational constraints)
- Amendments to a specification
- Description of construction requirements
- Description of material requirements

New Special Provisions prepared by ATMS designers are used in Contracts initially as Non-Standard Special Provisions. These provisions can become Standard Special Provisions if, there is an ongoing need for the tender item defined by the Special Provision and Ministry ATMS staff make a decision to implement the Special Provision.

The examples given on the following pages illustrate the typical types of Special Provisions.

B.4.1 Standard Special Provisions

The numbers for Standard Special Provisions are assigned by the Design and Contract Standards Office and published in the Contract Preparation System (CPS). These Special Provisions apply throughout the province.

Standard Special Provisions may be either general or item specific, with the latter requiring the addition of item numbers.

- General Special Provisions (Standard or Non-Standard) - General Special Provisions do not relate to any one specific tender item, but apply to either a number of tender items or the contract as a whole.

- Item Special Provisions (Standard or Non-Standard) - Item Special Provisions relate to a specific tender item and their titles consist of the appropriate tender item description. Item Special Provisions are noted with "SP" on the tender form, following the specification number, for each tender item modified or controlled by a Special Provision. The "SP" symbol may represent one or more Special Provision.

There are also two types of Standard Saps: the "S" and the "F" SP.

The S type Saps are automatically listed by CPS or manually by the designer and are included in the package, as is, by the CPCS.

The F type SPs are fill-in forms that should be filled in by the designer with the information applicable to the work under the item. This can be done by using the edit mode in the CPS.

B.4.2 Non-Standard Special Provisions

Non-Standard General Special Provisions are prepared for specific requirement in a project.

Non-Standard Item Special Provisions are prepared for specific items of work or supply of equipment required for the project. The document is prepared in Microsoft Word and submitted to the ATM Section for review. Once approved, it is submitted to the Contract Review Officer assigned to the project for insertion to the list of item SPs for the project in the CPS. The method of writing a Special Provision is discussed in Electrical Engineering Manual Volume 3. A Non-Standard Special Provision will be identified on the tender form as "SP" if it is item specific. Frequently used non-standard SPs are listed in CPS.

B.4.3 Information to Contractors (Operational Constraints)

A situation may exist where some restraints must be placed on the Contractor, for example, to address restrictions on existing system downtime, staging of the work, coordination with other related activities such as utility connections, etc. Operational constraints increase the cost of a contract, so their impact on the contract should be carefully reviewed. The costs resulting from these restrictions are generally not applicable to any one tender item. Therefore, the Special Provisions introducing the restrictions do not apply to any one tender item and should be inserted as General Special Provisions, for example, “Quality Control, Documentation and Testing for ATMS Work”

Any information that would aid the Contractor in making a bid appropriately reflecting the requirements may be added by using a Special Provision.

B.4.4 New Construction Requirements

A new complex construction requirement covered by a Non-Standard Special Provision should be written with the completeness and style of a specification by considering the "10 section" format.
The 10 generic sections of a construction specification are:

1	SCOPE	6	EQUIPMENT
2	REFERENCES	7	CONSTRUCTION
3	DEFINITIONS	8	QUALITY ASSURANCE
4	DESIGN & SUBMISSION REQUIREMENTS	9	MEASUREMENT FOR PAYMENT
5	MATERIALS	10	BASIS OF PAYMENT

Not all sections may be necessary, but use of the applicable section will improve the understanding and clarity of the Special Provision. If a new requirement is less complicated, a one-paragraph format may be used combining Measurement for Payment and Basis of Payment along with reference to the work required as detailed on the contract drawings. It must be stressed that Measurement and Basis of Payment clauses are to appear in all Non-Standard Special Provisions that control a contract item not covered by a standard specification.

Electrical Engineering Manual Volume 3 contains detailed guidelines for writing of Special Provisions.

B.4.5 Work Project (WP) Administration

Refer to 'CPS Help' regarding Work Project Administration and the following topics:

a) Backup b) Restore c) Combine d) Rename e) Change Owner f) Authorize g) Unlock

B.4.6 List of Standard Special Provisions

The Standard Special Provisions used for the particular work projects are listed automatically in the Standard Special Provision (SSP) list (Work Project-Reports-Included SSP List) once a tender item is included in the Tender Item List (D4). It is up to the designer to edit the SSP list, if there are SPs listed that are redundant to the work project.

The following pages provide a listing of the ATMS Standard Special Provisions, in numerical order. The column titled "DATED" indicates the date shown on the Standard

Special Provision, as published. The column titled "IMP'N DATE" indicates that all contracts advertised on or after that date shall use this SP edition, if warranted.

As an example, if a project is advertised on April 1, and the implementation date of SPxxxSxx is also April 1, then, SPxxxSxx must be included/identified when the project is submitted to Contract Preparation and Control Section of the Contract Management Office (which will be prior to April 1) CPS automatically includes the applicable implemented standard SPs to items required in the contract.

If no IMP'N DATE is shown, the Standard Special Provision still applies but no historical record of the implementation date exists.

The text of all the Standard Special Provisions included in the list is found at the end of this chapter.

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
100S62	AMENDMENT TO MTO GENERAL CONDITIONS OF CONTRACT, APRIL 2005	All contracts with "ATMS Maintenance and Warranty".	September, 2007	
106S05	AMENDMENT TO OPSS 106, NOVEMBER 2004	All Contracts with ATMS work.	February, 2009	
168F10	ADVANCED TRAFFIC MANAGEMENT SYSTEM OPERATIONS	All Contract with ATMS component requiring interface with the existing operational system.	September, 2007	
168F14	QUALITY CONTROL, TESTING AND DOCUMENTATION FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK	All Contracts with ATMS work.	September, 2007	
168S20	PROTECTION OF EXISTING ELECTRICAL SYSTEM	All Contracts with ATMS work.	September, 2007	
168F31	INCENTIVE/DISINCENTIVE FOR REINSTATEMENT OF LOOP DETECTORS	All pavement resurfacing Contracts affecting existing ATMS loops and with the approval of ATMS Project Manager.	September, 2007	
168S32	NTCIP FOR VARIABLE MESSAGE SIGNS	Always with the items: Variable message signs Portable variable message sign, trailer mounted Fixed support Mountable variable Message signs	September, 2007	
599S27	BOLLARDS	Always with this item.	September, 2007	

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
681F15	TRAINING FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.	Always with this item.	September, 2007	
681F17	SPARE COMPONENTS FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.	Always with this item.	September, 2007	
681F19	SYSTEM INTEGRATION TESTING FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.	Always with this item.	September, 2007	
681F25	MAINTENANCE AND WARRANTY FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.	Always with this item.	September, 2007	
681F32	GROUND DEPLOYMENT OF PORTABLE VARIABLE MESSAGE SIGNS- Item No. FIXED SUPPORT DEPLOYMENT OF VARIABLE MESSAGE SIGNS- Item No.	Always with this item, except for capital Contracts.	September, 2007	
681F34	MAINTENANCE AND WARRANTY FOR PORTABLE VARIABLE MESSAGE SIGNS - Item No.	Always with this item.	September, 2007	
682S01	ATMS FIELD CABINET MAINTENANCE SITES – Item No.	Always with this item.	September, 2007	
682S07	FLEXIBLE DUCTS BY SUBSURFACE INSTALLATION - Item No. RIGID DUCTS DIRECT BURIED - Item No. RIGID DUCTS DIRECT BURIED (TEMPORARY) - Item No.	Always with these items.	February, 2009	
682S08	SURFACE MOUNTED DUCT SYSTEMS - Item No.	Always with this item.	February, 2009	

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
682S09	EXTRA LOW VOLTAGE CABLES, IN DUCTS - Item No. EXTRA LOW VOLTAGE CABLES, IN DUCTS (TEMPORARY) - Item No. EXTRA LOW VOLTAGE CABLES IN SAWCUT SLOTS - Item No. SAWCUT SLOT FOR EXTRA LOW VOLTAGE CABLES – Item No.	Always with these items.	February, 2009	
682S12	POWER SUPPLY CABINETS - Item No.	Always with this item.	February, 2009	
682S13	CONCRETE POLES, DIRECT BURIED IN EARTH - Item No.	Always with this item.	February, 2009	
682S14	CONCRETE PADS - Item No.	Always with this item.	February, 2009	
682S15	BASE MOUNTED COMMUNICATION PEDESTALS - Item No.	Always with this item.	September, 2007	
682S16	CONTROLLER CABINETS - Item No.	Always with this item.	September, 2007	
682S17	CONTROLLERS - Item No.	Always with this item.	September, 2007	
682S18	LOOP VEHICLE DETECTOR SENSOR UNITS - Item No.	Always with this item.	September, 2007	
682S19	LOOP DETECTORS - Item No. LOOP DETECTORS (TEMPORARY) - Item No.	Always with this item.	September, 2007	
682S20	TEST EXISTING LOOP DETECTORS- Item No.	Always with this item.	September, 2007	
682F22	REMOVAL OF ADVANCED TRAFFIC MANAGEMENT SYSTEM EQUIPMENT - Item No.	Always with this item.	February, 2009	
682S23	INNER CHAMBERS - Item No.	Always with this item.	September, 2007	

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
682S25	CONCRETE FOOTINGS IN EARTH– Item No.	All ATMS Contracts with this item.	February, 2009	
682S26	NON-INTRUSIVE TRAFFIC SENSORS (Microwave) – Item No.	Always with this item.	February, 2009	
682S27	CONTROLLER CABINETS, POLE MOUNTED – Item No.	Always with this item.	September, 2007	
682S28	UNINTERRUPTIBLE POWER SUPPLY UNITS – Item No.	Always with this item.	February, 2009	
682S29	MAGNETIC DETECTORS– Item No.	Always with this item.	February, 2009	
682S30	CONCRETE POLE, DIRECT BURIED IN EARTH WITH CAMERA RAISING AND LOWERING SYSTEM – Item No.	Always with this item.	February, 2009	
682S31	MAGNETIC DETECTOR CARDS - Item No.	Always with this item.	February, 2009	
682S32	EXTRA LOW VOLTAGE CABLES FOR MAGNETIC DETECTORS, IN DUCTS - Item No. EXTRA LOW VOLTAGE CABLES FOR MAGNETIC DETECTORS, IN DUCTS (TEMPORARY) - Item No.	Always with these items	February, 2009	
682S33	FLEXIBLE DUCTS BY SUBSURFACE INSTALLATION FOR MAGNETIC DETECTORS - Item No. RIGID DUCTS CONCRETE ENCASED FOR MAGNETIC DETECTORS - Item No.	Always with these items	February, 2009	

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
683S01	FIBRE OPTIC COMMUNICATION CABLES, IN DUCTS - Item No. FIBRE OPTIC COMMUNICATION CABLES, IN DUCTS (TEMPORARY) - Item No. FIBRE OPTIC COMMUNICATION CABLES, AERIAL ON MESSENGER CABLE - Item No. FIBRE OPTIC COMMUNICATION CABLES, AERIAL ON MESSENGER CABLE (TEMPORARY) - Item No.	Always with these items.	February, 2009	
683S02	SPLICE ENCLOSURES FOR FIBRE OPTIC CABLES - Item No.	Always with this item.	September, 2007	
683S03	DATA INTERFACE CABLES - Item No.	Always with this item.	September, 2007	
683S04	VIDEO TRANSMITTERS AND RECEIVERS - Item No.	Always with this item.	September, 2007	
683S07	VIDEO SYSTEM LINE UP AND TEST - Item No.	Always with this item.	September, 2007	
683S09	FIBRE OPTIC MODEMS - Item No.	Always with this item.	September, 2007	
683S10	PORT SHARING DEVICES - Item No.	Always with this item.	September, 2007	
683S11	DATA SYSTEM LINEUP AND TEST - Item No.	Always with this item.	September, 2007	
683S19	DROP / INSERT NODES - Item No. CHANNEL PORTS - Item No.	Always with this item.	September, 2007	
683S21	LEASED LINE MODEMS - Item No.	Always with this item.	September, 2007	

SSP	TITLE	WARRANT	DATED	IMPL'N DATE
683S22	WIRELESS ETHERNET BRIDGES - Item No	Always with this item.	September, 2007	
683S23	DIGITAL VIDEO ENCODERS AND DECODERS- Item No	Always with this item.	September, 2007	
683S24	PORT SERVERS- Item No	Always with this item.	September, 2007	
683S25	ETHERNET SWITCHES- Item No	Always with this item.	September, 2007	
683S26	FIBRE OPTIC ETHERNET MODEMS- Item No	Always with this item.	September, 2007	
684S01	OUTDOOR CLOSED CIRCUIT TELEVISION CAMERAS - Item No.	Always with this item.	September, 2007	
684S03	OUTDOOR PAN / TILT UNITS - Item No.	Always with this item.	September, 2007	
684S07	CLOSED CIRCUIT TELEVISION VIDEO MONITORS – Item No.	Always with this item.	September, 2007	
684S10	DOME CAMERAS- Item No.	Always with this item.	September, 2007	
685S01	VARIABLE MESSAGE SIGNS - Item No.	Always with this item.	September, 2007	
685S06	PORTABLE VARIABLE MESSAGE SIGNS, TRAILER MOUNTED - Item No.	Always with this item.	September, 2007	
685S07	FIXED SUPPORT MOUNTABLE VARIABLE MESSAGE SIGNS - Item No.	Always with this item.	September, 2007	
687S01	RACK ASSEMBLIES - Item No.	Always with this item.	September, 2007	

Table B-2. ATMS Special Provision List.

B.4.7 Identification of Non-Standard Special Provisions

Titles of Non-Standard Special Provisions (NSSP) used for the particular work projects are entered by the designer into CPS. These entered Non-Standard SP titles are then shown on the tender document page entitled "NSP List" (Cross reference report of all project non-standard special provisions). Note that only one (1) NSSP per contract item is allowed in CPS.

B.4.8 Policies (Directives)

The following directives described the rules to be followed when implementing special provisions. Although the directives need updating, the principle outlined still applies. Some of the Ministry offices mentioned may no longer exist, but the readers are advised to contact the Ministry, if necessary, and ask for the equivalent office. When the CDED is mentioned, it includes this manual, the Electrical CDED. These directives are found in the CPS:

(a) Q-C013 - Implementation of revision to standards, procedures and policies that affect the preparation of the capital construction contract package.

(b) P-C066 - Processing of Standard Special Provisions

AMENDMENT TO MTO GENERAL CONDITIONS OF CONTRACT, APRIL 2005

Special Provision No. 100S62 September 2007

GC1.07 Definitions

Subsection 1.07 is amended by the addition of the following definitions:

ATMS Phase I of Contract: means items of ATMS work listed in the tender as Phase I items.

ATMS Phase II of Contract: means items of work listed in the tender as Phase II items. The work for ATMS Phase II items shall commence upon completion of ATMS Phase I items of work in their entirety including all deficiencies, clean up, site restoration, final inspection and submission of Contract Documentation.

GC1.08 Substantial Performance

Subsection 1.08 is amended by the addition of the following:

The Work under ATMS Phase II of Contract shall not be included in the criteria for Substantial Performance and Contract Completion.

GC8.02.04 Advance Payments for Material

Clause 8.02.04 is amended by the addition of the following to the paragraph 01:

Advance payment for material shall not apply to ATMS Contract items that require Proof of Performance Testing. Payment for each of these items will be made following the approval of the Proof of Performance Test Results.

WARRANT: All Contracts with "ATMS Maintenance and Warranty".

AMENDMENT TO OPSS 106, NOVEMBER 2008

Special Provision No. 106S05 February 2009

106.03 DEFINITIONS

Section 106.03 is amended by deletion of the first paragraph and addition of the following:

For the purpose of this Special Provision and all other ATMS Special Provisions in the Contract, the following abbreviations shall apply:

AAS - Arterial Advisory Sign
ABL - Auto Black Level
AGC - Automatic Gain Control
APL - Average Picture Level
ASTM - American Society for Testing and Materials
ATC - Advanced Traffic Controller
ATMS - Advanced Traffic Management System (Ministry of Transportation, Ontario)
BER - Bit error rate
BP-23 - Department of Communications, Broadcast Procedure 23
CCD - Charge-Coupled Device
CCR - Camera Control Receiver
CCS - Central Control System
CCT - Camera Control Transmitter
CCTV - Closed Circuit Television
CD - Carrier Detect
CDIN - Central Drop and Insert Node
CODEC - Encoder - DECoder
CSC - Camera Control and Video Switch System External Computer
CSK - Camera Control / Switch Keypad
CSS - Camera Control and Video Switch System Software
CTS - Clear to Send
DCE - Data Communications Equipment
DCP - Data Channel Port
DDE - Data Distribution Equipment
DRAM - Dynamic Random Access Memory
DTE - Data Terminal Equipment
DTR - Data Terminal Ready
EEPROM - Electrically Erasable Programmable Read Only Memory
EMI - Electro-Magnetic Interference
EPROM - Erasable Programmable Read-Only Memory.
FDIN - Field Drop and Insert Node
FDVM - Frequency Division Video Multiplexer
FDVM(R) - Redundant Frequency Division Video Multiplexer
FDVDM - Frequency Division Video Demultiplexer
FOM - Fibre optic modem
FOEM - Fibre optic Ethernet modem
HAK - Hardware Address Key
HAR - Highway Advisory Radio

HOV - High Occupancy Vehicle
LCP - LAN Channel Port
LCS - Lane Control Signs
LDS - Limited Distance Data Set
LED - Light Emitting Diode
MM - Multi mode
MSA – Material Selection Documentation Acceptance
MIL – Military Specification
NITS – Non-intrusive Traffic Sensor
NCTA - National Cable Television Association
NTCIP – National Transportation Communications for ITS Protocol
NTSC - National Television Systems Committee
OEM - Original Equipment Manufacture
OIE - Optical Interface Equipment
OTDR - Optical Time Domain Reflect meter
OTSCES - Ontario Traffic Signal Control Equipment Specifications
PCB - Printed Circuit Board
PIN - P-type, intrinsic, N-type
PROM - Programmable Read-Only Memory
PSD - Port Sharing Device
PVMS - Portable Variable Message Signs
QWS - Queue Warning System
ROM - Read Only Memory
RMS - Ramp Metering System
RTS - Request To Send
RXD - Receive Data
RTS - Request to Send
SCT - Standby Camera Control Transmitter
SM - Single mode
SONET - Synchronous Optical Network
SRAM - Static Random Access Memory
TOC - Traffic Operations Centre (when shown with B or T prefix means Burlington or Toronto respectively)
TXD - Transmit Data
UART - Universal Asynchronous Receiver/Transmitter
VCP - Voice Channel Port
VDE - Video Distribution Equipment
VDS - Vehicle Detector Station
VMS - Variable Message Sign.
VSK - Video Switch Keypad
VSLS – Variable Speed Limit Signs
VSM - Video Switch Matrix

For the purpose of this Special Provision and all other ATMS Special Provisions in the Contract, the following definitions shall apply:

Advanced Controller Unit: means a microprocessor based unit for control or reporting of Vehicle Detection, Variable Message Signs, Ramp Metering, Lane Control Signs, Arterial Advisory Signs, or, where used in general terms, a Camera Control Receiver.

Assembly: means a complete machine, structure or unit of a machine that was manufactured by fitting together parts and/or modules.

Cabinet: means an outdoor enclosure for housing a Controller Unit and associated equipment. Type 401 C, D, S and R as pursuant to the Ontario Traffic Signal Control Equipment Specifications.

Central Computer System: means the combination of the Advanced Traffic Management System application software, operating system, and computer hardware. The computer hardware consists of many separate components, including several stand alone computers.

Central: means see ‘Central Computer System’.

Certificate of Compliance: means a certificate signed by the manufacturer of the material or the manufacturer of assembled materials stating that the materials involved comply in all respects with the requirements of the specifications.

Channel: means an information path from a discrete input to a discrete output.

Channels: means general purpose serial input/output channels for communications with the computer peripherals and field equipment (via the communications subsystem).

COMPASS Operator(s): means person(s) at the TOC assigned to manage traffic flow on the highway network using system components and functions.

Dimming Scheme: means the circuitry which controls luminous output of pixels.

Downloading: means the transmission of data from a master or central computer system to a slave or a remote Controller Unit.

Element: means one pixel (or dot) of a VMS display matrix. The element can either be ‘on’ or ‘off’. Multiple pixels are required to show one character.

Ethernet: means local area network standard.

Interconnection: means an electronic, fibre optic or electrical connection between controller unit, located inside a controller cabinet, and other components housed in other enclosures.

Laboratory: means the laboratories authorized by the Owner to test materials involved in the Contract.

Master: means VDS, VMS, LCS or AAS Master Controller.

Matrix (w.r.t VMS): means a configuration of pixels giving a specific display format (e.g. a 5 x 7 dot display = 35 dot character matrix).

Military Specification: means current issues and/or revisions of standards or specifications issued by the U.S. Department of Defense.

Module (w.r.t. VMS): means a removable unit with a fixed pattern and identical to all other modules.

Module: means a functional unit that plugs into an assembly.

Motherboard: means a Printed Circuit Connector Interface Board to which other modules are connected.

Pixel: See ‘Element’

Poll: means an enquiry message sent from a master to a slave on a regularly timed basis to solicit information of a slave.

Portable VMS: means a scaled down version of a VMS intended for portable usage or fixed support installation.

Power Restoration: means power is said to be restored when the incoming line voltage equals or exceeds the specified minimum operating voltage for 50 milliseconds or longer. The minimum operating voltage shall be 95 VAC if not specified.

Power Failure: means a power failure is said to have occurred when the incoming line voltage falls below the specified minimum operating voltage for 50 milliseconds or longer. The minimum operating voltage shall be 95 VAC if not specified.

Prompt: means a message informing a user that a system is ready for the next command, message, or other user action.

Reaction Time: means the time between the occurrence of an event to the sensing of that event and providing an action to it.

Sign case: means the physical housing for an AAS, LCS, QWS, VSLS or VMS including doors, hardware, attachment brackets, module supports, and all associated internal equipment such as fans, convenience lights and environmental features.

Splice: means a mechanical device connecting two or more copper conductors, establishing an electrical contact and insulated equal to the cable in which it is installed or the joining of optical fibres to establish an optical link between two fibres.

Subsystem: means a subsidiary system within the Advanced Traffic Management System.

Terminal: means same as field terminal or Field Test Computer in the specifications; a device that has a microprocessor, keyboard and a display screen.

Traffic Operations Centre: means the centre comprising the main ATMS computer subsystem and operations centre.

User-definable Parameters: means parameters which can be modified on-line by the user via some interactive dialogue with the system.

Variable Message Sign: means overhead motorist information display sign capable of displaying variable or changeable messages in text or symbol graphics.

Watchdog timer: means a fail-safe mechanism or timer that upon expiring triggers a system reset. To prevent a system reset, the mechanism or timer must be reset at regular intervals, as defined by the OEM.

nU: means a unit of height measurement used for EIA 480 mm rack mounted equipment. The number ‘n’ multiplied by 44.45 mm specifies the equipment height.

106.05 MATERIALS

Section 106.05 of OPSS 106 is amended by addition of the following subsections:

106.05.01 Ordering of ATMS Materials

The Contractor shall submit to the Contract Administrator a proof of the ordering of all major materials, necessary for performance of the ATMS work, within seven (7) days of written authority of acceptance of MSA. The production of materials shall be subject to shop drawing approval. Failure to carry out this requirement shall not give cause for the Extension of Time due to late material deliveries and shall not be considered as sufficient reason to avoid application of Liquidated Damages.

When ordering ATMS Materials the Contractor shall indicate to the suppliers that Ministry of Transportation Ontario as the Owner of the materials and that any future notices regarding material recalls, enhancements, warnings, software upgrades and new releases shall be directed to the Ministry. The Contractor shall obtain the contact name for the Owner's representative from the Contract Administrator, to be provided to the suppliers when ordering ATMS Materials. This requirement applies to all materials requiring submission of MSA documentation.

106.05.02 Storage of Materials

ATMS materials shall be stored such that the environmental requirements as set out in the Contract are met. The Contractor shall arrange and pay for any warehousing, or other storage of ATMS materials, as may be required to fulfil the timing or environmental requirements of the Contract.

106.07 CONSTRUCTION

106.07.01.01 Contractor's Workers

Clause 106.07.01.01 is amended by the addition of the following:

Qualified electronics technicians shall be employed to do the following work:

a) RF equipment, installation, testing and maintenance;
b) Fibre optic equipment, cable splicing, testing and maintenance.

The Contract Administrator may request at any time that the Contractor provide proof of qualifications for the individual performing above work type. The qualifications shall include applicable education or training courses and minimum two years of practical experience.

Section 106.07 is amended by addition of the following subsection:

106.07.13 ATMS Work

106.07.13.01 General

ATMS materials shall be energized immediately following installation and all environmental equipment shall be operational.

106.07.13.02 Work Requiring Replacement of Existing Loop Detectors

If existing loop detector stations specified for replacement under this Contract are part of the operational COMPASS System, the Contractor shall provide 48 hours notice to the Contract Administrator prior to commencement of any milling operations affecting existing loops.

The existing loop detector cables shall be disconnected from the loop home-run cables at the roadside electrical chamber prior to commencement of any pavement milling operations. Any damage to the loop home-run cables or sensor units in the cabinets resulting from failure to disconnect the cables shall be rectified to the original conditions. The Contractor shall remove the existing cables, sensor units and any other damaged components and install new cables and equipment. Cables shall be removed and installed for their full lengths between the loop handhole and the cabinet without intermediate splices.

The Contractor shall also remove any extra existing detector cables that are not required for the current installation.

106.07.13.03 Seasonal Adjustments of ATMS Equipment

The Contractor shall make all seasonal adjustments required for outdoor equipment installed or modified under this Contract. The adjustments shall apply to the following type of equipment: type 401 cabinets, CCTV camera enclosures and VMS sign cases, as required by manufactures maintenance specifications.

Where equipment is installed under "summer" conditions (April 16 to October 15), baffle plates shall be removed from ventilation louvers, air filters shall be installed and fans shall be checked for proper operation. The baffle plates shall be stored within the cabinet.

Where equipment is installed under "winter" conditions (October 16 to April 15), air filters shall be removed from ventilation louvers, baffle plates shall be installed and heaters shall be checked for proper operation. The air filters shall be stored within the cabinet.

The adjustments shall also be carried out as many times as required over duration of the Contract.

WARRANT: All Contracts with ATMS work.

ADVANCED TRAFFIC MANAGEMENT SYSTEM OPERATIONS

Special Provision No. 168F10 September 2007

INTERFERENCE WITH ATMS OPERATIONS

The Contractor shall not interfere with the existing COMPASS subsystems except as otherwise directed in the Contract. The following general restrictions to operating subsystems apply:

1. Individual Elements

Work on individual elements (such as cabinets, enclosures, signs, cameras) may be carried out at any time permitted in the Contract.

The Contractor shall submit a detailed element interference plan to the Contract Administrator for approval a minimum of four weeks prior to commencing any work that may result in an element outage or prevent the element from performing its normal functions. The plan shall include what work will be done, any dependencies or staging, and maximum element interference duration. The plan shall be prepared to minimize interference durations and overall COMPASS impacts. The Contractor shall provide a minimum 72-hour notice to the Contract Administrator prior to the start of any work resulting in element interference.

2. Subsystems

Work requiring outage of a full or a substantial part of a subsystem shall be subject to the following allowable downtime constraints: *

VMS: ______________________________
PVMS: ____________________________
QWS: _____________________________
CCTV: _____________________________
VDS: _______________________________
Ramp Metering: ____________________
Communications: ___________________
Power: _____________________________
Other: _____________________________

The Contractor shall provide 72 hours advance notice prior to the intended disconnect of the above operational components and obtain the approval of the Contract Administrator prior to proceeding with this work. The subsystem shall be returned to full operation at all other times.

3. Access to Traffic Operations Centre (TOC)

Where the Contractor's work requires access to the Traffic Operations Centre (TOC), the Contractor shall make arrangements for the timing of the work and access to the Traffic Operations Centre (TOC) by contacting the Contract Administrator 72 hours in advance of the work.

Work within the Traffic Operations Centre (TOC) may be carried out between **________________________ Monday to Friday unless such work interferes with operational subsystems for which constrains are included in section 2 apply.

4. Impacts of New Installations on Existing System

Where new equipment is connected to or activated with the existing network and this equipment causes a network problem or failure, the Contractor shall remedy the situation immediately upon notification by the Contract Administrator. The network failures or problems shall be restored to the prior full functional condition and to the satisfaction of the Contract Administrator. If the Contractor fails to remedy the situation within the prescribed time, the Owner will apply the applicable sum as liquidated damages.

NOTES TO DESIGNER:

* Fill out restrictions for the subsystems as applicable for the scope of work in consultation with COMPASS Operations.

** Fill out the hours of access to Traffic Operations Centre (TOC).

WARRANT: All Contract with ATMS component requiring interface with the existing operational system.

QUALITY CONTROL, TESTING AND DOCUMENTATION FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK

Special Provision No. 168F14 September 2007

1. SCOPE

This Special Provision describes the general requirements for the Contractor's quality control, testing and documentation for products furnished under the Contract. Specific requirements are included in the Special Provisions for the various items of equipment to be furnished by the Contractor. The term "equipment" refers to all materials and components supplied by the Contractor.

2. REFERENCES

This Special Provisions refers to the following standards, specifications or publications:

International Organisation for Standardization (ISO):

ISO 9660 Information processing - Volume and file structure of CD-ROM for information interchange

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Environmental Testing: shall be carried out at an independent test facility. The environmental test shall include 24 hours of successful equipment operation at both hot and cold environmental extremes for a sample of 10% of the units intended for supply under this Contract, selected at random by the Contract Administrator or independent test facility representative. In the event that the environmental tests on a representative sample of equipment are not successful, the Contractor shall repair, modify or replace the equipment and shall be prepared to test up to 100% of the units intended for supply under this Contract at no additional cost.

Environmental Tests Failure: means the environmental tests on the units intended for supply under this Contract were not successful. In the event of the environmental tests failure, the Contractor shall be prepared to replace the units intended for supply under this Contract with the alternative equipment at no additional cost.

Equipment Testing: shall apply to all equipment. Equipment testing shall include test procedures, PIT, POP, SIT, and test results for all clauses identified in the Testing Requirements Table (TRT).

PIT: means Pre-Installation Testing and includes all testing undertaken prior to installation of equipment and may also include testing of mock-ups, prototype testing and normal factory production testing.

POP: means Proof of Performance Testing and includes all testing undertaken following the installation of equipment to verify the physical and operational features of each item of equipment and each ATMS subsystem.

SIT: means System Integration Testing and includes all testing required to verify the harmonious operation of all ATMS subsystems described in the Contract.

TRT: means Testing Requirements Table and identifies the PIT, POP, and SIT equipment testing requirements for specific Contract items.

4. DESIGN SUBMISSION AND REQUIREMENTS

4.1 General

Documentation, including shop drawings, catalogue sheets, calculations, drawings, diagrams, test print-outs, photographs and text shall be provided by the Contractor to a level of detail such that the Contract Administrator can achieve a reasonable level of assurance that the equipment that is furnished by the Contractor is in accordance with the specifications of the Contract. The documentation shall also be used to provide records for future operational and maintenance activities. The Contractor shall show the appropriate document submittal and review timeframes on the Contract schedule.

4.2 Submission of Documentation

The following documentation submissions are required:

a) Material selection documentation
b) Design documentation (if applicable)
c) Test procedures documentation (including for prototype where required)
d) Test results documentation (including for prototype where required)
e) Software documentation (if applicable)
f) Data communications protocol documentation (if applicable)
g) System documentation (if applicable)
h) As-built drawings
i) Installation and operation manual
j) Maintenance and service manual

For all submissions, the Contractor shall initially provide one (1) hard copy and one (1) electronic copy of all documentation required for the submission. The documentation shall be complete and no partial submissions will be accepted. For all final submissions, the Contractor shall provide two (2) hard copies and two (2) electronic copies of all documentation required for the submission.

The Contract Administrator will review and return the hard copy within three (3) weeks of the initial documentation submission noting the submission is acceptable, or with comments noting the submissions is unacceptable. If the documents are not acceptable, the Contractor shall make a single second submission of the amended documents within three weeks (3) and the Contract Administrator will return the submission within two (2) weeks. The second submission shall be complete and shall address all comments made by the Contract Administrator under the first submission. An incomplete submission will not be accepted. Following resolution of all comments, the Contractor shall provide the final submission.

The documentation shall be of professional quality including printed text, CAD produced drawings and photographic material if applicable. All hard copy documentation shall be properly bound in separately indexed 3-ring binders of 75 mm maximum thickness, indexed by item. All electronic documentation shall be submitted on one or more labelled CD disk media formatted with ISO 9660 file system, organized with a folder for each submission, with subfolders for each item, as shown in the following example:

Material Selection Documentation
Item #24 Fibre Optic Communications Cables, In Ducts
Item #25 Ethernet Hubs
Item #26 Portable Variable Message Signs
. . .
Pre-Installation Test Procedures
Item #24 Fibre Optic Communications Cables, In Ducts
Item #25 Ethernet Hubs
Item #26 Portable Variable Message Signs
. . .

The files for each item shall be provided in the Owner's current standards of MS Word or Adobe Acrobat for text and the Owner's current standard of AutoCAD for drawings. These text and drawing files shall also be consolidated into a single Adobe Acrobat file for each item.

4.3 Material Selection Documentation

The material selection documentation shall demonstrate compliance with all clauses in the specifications, and consist of the following:

a) Name, address and telephone number of the proposed manufacturer;
b) An electronic copy of a schedule in MS Project outlining the times for preparation and submission of design documentation, software documentation and data communications protocol documentation (as applicable);
c) Brochures, catalogue materials, references or other materials which would be helpful to the Contract Administrator for acceptance of the submission;
d) Specifications for all interconnection cables;
e) Development/Milestone and Production Schedules.

Where catalogue information is provided for an item and the Contractor proposes to supply that particular product, the equipment shall be supplied with any enhancements or modifications necessary to meet the requirements as set out in the Special Provision for the item. Documentation shall be submitted describing those enhancements or modifications in addition to the catalogue information.

No later than three weeks following the Contract award date, the Contractor shall provide the initial submission of all required documentation. The submission will be returned to the Contractor and noted "Permission to Construct" by the Contract Administrator if found to be acceptable, or will be marked with corrections or comments where found to be non-acceptable. Where "Permission to Construct" has been indicated, the final submission shall be made to the Contract Administrator.

The "Permission to Construct" stamp, indicating acceptance in principle by the Contract Administrator, shall not relieve the Contractor of any responsibilities under the Contract for full performance of the work should errors or omissions in the documentation be discovered at a later date. Fabrication shall not commence until "Permission to Construct" has been granted.

Once fabrication of the equipment has commenced, materials and dimensions shown in the accepted documentation shall not be changed without review of the Contract Administrator. Where the Contractor wishes to make changes, it is the responsibility of the Contractor to notify the Contract Administrator of any Contract non-compliance with respect to the equipment to be supplied and to submit documentation of the changes for review.

4.4 Design Documentation

Design documentation for each item shall be provided for review by the Contract Administrator prior to acquiring any components of custom design for equipment. Design documentation shall consist of all shop drawings, parts lists and text required to define the configuration of the product.

Where physical strength requirements for outdoor exposure of equipment form a part of the Contract specifications, the design documentation shall include a signed statement from a Professional Engineer attesting to the strength of the product.

4.5 Test Procedures Documentation

The Contractor shall provide test procedure documentation for all tests required under the Contract. The test procedures documentation shall detail the intended method of testing based on the item requirements referenced in the testing requirements table (TRT). The following is a sample of the TRT:

CLAUSE	PIT	POP	SIT
5.1.1	√		
5.2.2	√	√	√
5.4.2	√	√	

The method of testing must ensure that each clause listed in the TRT can be successfully demonstrated. The procedures shall include diagrams to show the system test set-up and test points for recordings. The documentation shall also address the format of the test results documentation. The following is a sample format for the test results documentation:

<table>
<tr><td colspan="2">Item #:

Item Description:

Test:</td><td colspan="2">Tester:

Date:</td></tr>
<tr><td colspan="4">Test Set-up:</td></tr>
<tr><td>Clause</td><td>Test Procedure</td><td>Expected Results</td><td>Actual Results</td></tr>
<tr><td></td><td></td><td></td><td></td></tr>
<tr><td colspan="4">Witnessed:

(This Does Not Constitute Approval)

Reviewed and Approved:</td></tr>
</table>

The Contractor shall coordinate the timing of submissions and reviews such that the final test procedures documentation is submitted at least three (3) weeks in advance of the scheduled test activity. The Contractor shall not proceed with the test activities before the test procedures are reviewed and approved by the Contract Administrator.

4.6 Test Results Documentation

Test results documentation shall demonstrate the results of all tests in the format previously accepted under the test procedures documentation submission. Communications system PIT and POP test results shall be presented in a line diagram and/or tabular format denoting the test points, expected results, and actual results. All areas of non-compliance with the specifications shall be noted as well as the action to be taken.

Test results documentation shall be submitted to the Contract Administrator within two (2) weeks of completion of each stage of testing (i.e. PIT, POP, etc.)

4.7 Software Documentation

Where software is required under the Contract and where configuration, modification or development is required in order to achieve the functionality described in the Contract, the following documentation shall be supplied: *

a) Compiled media copy of the software with all required installation media on CD(s) or DVD

b) Installation and Operation Manuals
c) Configuration and System Administration Manual
d) Maintenance and Service Manuals
e) All applicable licences
f) MIB definitions
g) ______________________________________
h) ______________________________________

At the sole discretion of the Contract Administrator, certain documents may not be required to be supplied.

The final software documentation submission shall be provided to the Contract Administrator at least five (5) weeks in advance of site installation of the equipment.

4.8 Data Communications Protocol Documentation

Full documentation shall be supplied to the Contract Administrator for any and all data communications protocol for the following equipment supplied under this Contract: **

a) ______________________________________

b) ______________________________________

c) ______________________________________

For NTCIP interfaces and/or vendor specific private interfaces, the documentation shall include object definitions with valid ranges in ASN.1 notation in electronic format.

The Owner shall be accorded the right to use the protocol for any purpose deemed necessary. This does not include the right to market, sell or disclose the protocol to a third party but does include the right to share, under a non-disclosure agreement, with other parties for Owner's use.

The final data communications protocol documentation submission shall be provided to the Contract Administrator at least five (5) weeks in advance of site installation of the equipment.

4.9 Final System Documentation

The Contractor shall prepare documentation compiling the test procedures, test results and areas of non-compliance with the Contract specifications and shall detail overall system configuration, operation and maintenance with the use of block level diagrams. All equipment in the system shall be identified with module and block numbers.

A functional description of each element of the system and how they function together in a complete system should be explained.

Operating procedures shall be provided describing the initial turn-on, adjustments to ensure the system is operating within the performance requirements, and system level corrective maintenance procedures.

The final system documentation submission shall be provided to the Contract Administrator as a condition of Contract Phase I acceptance.

4.10 As-built Drawings

The Contractor shall submit as-built drawings to the Contract Administrator in hard copy with as-constructed revisions marked in red colour. The final as-built drawing submission shall be provided to the Contract Administrator as a condition of Contract Phase I acceptance.

4.11 Installation and Operation Manuals

The manual shall document in detail the installation and operation of the equipment on an item by item basis with clearly detailed illustrations including layout of controls, displays, and all other information required to correctly operate a fully functional unit. The model number(s), all options provided, and the correct settings and configuration shall be clearly shown. All modifications to equipment must be documented.

The manual shall detail, at the system engineering level, the procedures for installation of the software on the given computer system. The manual shall also address the operation of the software at three different levels; beginner, intermediate and advanced.

The Contractor is responsible for generating the required documentation in the event that it is not available from the manufacturer.

The final installation and operation manual submission shall be provided to the Contract Administrator as a condition of Contract Phase I acceptance.

4.12 Maintenance and Service Manuals

The manual shall document in detail the maintenance and service aspects of the equipment on an item by item basis with clearly detailed illustrations including schematic diagrams. The manual shall contain a troubleshooting guide to enable technicians of the Owner, or others, to carry out maintenance operations down to the modular block level.

The manual shall provide sections which completely describe the theory of operation using block diagrams and schematic drawings, diagnostic and repair procedures for corrective maintenance of the unit, assembly and disassembly instructions and drawings, layout drawings showing location of all components, complete components listing showing component type, ratings, cost and acceptable manufacturers. Complete schematic diagrams to the component level shall be provided. The manual shall fully describe all adjustments and alignment procedures and provide descriptions of expected signals at all test points and outputs. Detailed specifications of equipment performance shall be provided.

The final maintenance and service manual submission shall be provided to the Contract Administrator as a condition of Contract Phase I acceptance.

4.13 Documentation for Phase I Acceptance

The following documentation must be submitted and approved in order to achieve acceptance of Phase I of the Contract:

a) Material Selection Documentation
b) Design Documentation
c) Test Procedures and Results for all levels of testing
d) Software Documentation

e) Data Communications Protocol Documentation
f) Final System Documentation
g) As-built Drawings
h) Installation and Operation Manuals
i) Maintenance and Service Manuals
j) Contract Deficiency List
k) Letter of Credit for Contract Phase II

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

Where testing of representative samples of equipment is required, the test shall include a sample of 10% of the units intended for supply under this Contract, selected at random by the Contract Administrator or independent test facility representative. Any additional testing required as a result of test failures shall be done at no additional cost to the Owner. In the event that tests on representative samples of equipment are not successful, the Contractor shall be prepared to test up to 100% of the units intended for supply under this Contract at no additional cost.

The Contractor shall endeavour to ensure that production facilities for the equipment as supplied carry out a thorough and conscientious Quality Control program. Where quality and testing standards issued by independent authorities are called for in the specifications, the Contractor shall ensure that the proper equipment and facilities are available for carrying out of the tests.

Where defects in the performance of the Owner's existing subsystems or components are found, the existing systems shall be repaired as directed by the Contract Administrator, and shall be administered under the Change Order provisions of the MTO General Conditions of Contract.

7.1 Quality Control

As proof of equipment certification the Owner will accept one of the following:

a) A compliance and test results certificate from an approved independent testing laboratory operating at arms length from the Contractor, his supplier and the manufacturer.

b) A compliance and test results memorandum from a Professional Engineer.

The Contract Administrator and agents of the Owner may request to attend any test. The Contractor shall arrange suitable times and locations for the tests and shall co-ordinate with the Contract Administrator such that witnessing of tests is practical. The Contractor shall provide the Contract Administrator a minimum of seven (7) days notice of when all tests shall take place.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment for quality control, testing (except SIT) and documentation shall be included in the Contract price for the applicable items.

NOTES TO DESIGNER:

* Fill out required software documentation.

** Fill out required data communications protocol documentation.

WARRANT: All Contracts with ATMS work.

PROTECTION OF EXISTING SYSTEM

Special Provision No. 168S20 September 2007

ACCIDENTAL DAMAGE TO EXISTING ATMS PLANT

In cases where the Contractor damages ATMS fibre optic cables, electrical cables or equipment, the Contractor agrees to pay to the Owner a sum of $ 60,000. The sum shall be applied for each occurrence of such damage.

As an immediate remedy, the Contractor shall be required to make temporary splices and/or other repairs and restore operation of the ATM System as soon as possible. If any portion of the ATM System is inoperable, as a result of the damage caused by the Contractor, for more than four hours, the Contractor agrees to pay the Owner the additional sum of $10,000 for each day of the downtime.

As a permanent remedy, the Contractor shall also be required to restore the ATM System to its original condition, remove the existing cables, repair the ducts and ground wire and install new cables. Cables shall be removed and installed for their full lengths between splice points without intermediate splices (full splice points in case of fibre optic cables). The damaged equipment shall be replaced with identical or approved equivalent equipment. The Contractor shall notify the Contract Administrator 7 days in advance of the commencement of the work. The Contractor shall retain pre-approved personnel or sub-Contractors qualified to complete the ATMS work.

All work shall be carried out using the materials, construction methods and specifications applicable to this work, currently in use by the Ministry.

The applicable sum shall be deducted from the next progress payment due to the Contractor. The Contract Administrator shall be the sole judge as to the extent of damage to the ATM System and the length of a resulting downtime when accessing the applicable sum to be deducted.

WARRANT: All Contracts with ATMS work.

INCENTIVE/DISINCENTIVE FOR REINSTATEMENT OF LOOP DETECTORS

Special Provision No. 168F31 September 2007

The Contractor is advised that each of the vehicle detector loops affected by construction operations must be reinstated within the permissible downtime.

The permissible downtime for each vehicle detector station is *________calendar days or prior to completion of the Contract, whichever is less. The downtime begins on the day the first loop in the vehicle detector station is disconnected/disabled.

The Contractor will be paid an incentive provided that the vehicle detector station is made operational within or prior to the permissible downtime. This incentive will be $50 per loop that is reinstated within the vehicle detector station.

If the Contractor fails to reinstall and make operational any individual vehicle detector station within the permissible downtime, the Owner will make a deduction from the Contract payment of $50 per loop initially and $10 per loop for each additional calendar day of delay with no maximum. These deductions are in addition to the applicable Liquidated Damages specified elsewhere in the Contract.

The Incentive/Disincentive provision will be paid or deducted from monies due to the Contractor at the completion of the Contract.

Compensation to the Contractor for having to schedule his operations to meet these requirements, including if require, extra crews for night work, shall be deemed to be included in the Contract bid price and no additional payment shall be made except for payment outlined above.

NOTES TO DESIGNER:

* Fill in the number of days of permissible downtime.

WARRANT: All pavement resurfacing Contracts affecting existing ATMS loops and with the approval of ATMS Project Manager.

NTCIP FOR VARIABLE MESSAGE SIGNS

Special Provision No.168F32 July 2009

1. SCOPE

This Special Provision covers the requirements for the delivery, installation, documentation and testing of National Transportation Communications for ITS Protocol (NTCIP) for Portable Variable Message Sign (PVMS) and Variable Message Sign (VMS) controllers, referred to hereafter as Dynamic Message Sign (DMS) controllers.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

National Transportation Communications for ITS Protocol (NTCIP):

NTCIP 1201: 1996 - Global Object Definitions
NTCIP 1201 Amendment 1: 1998 - NTCIP Global Object Definitions Amendment 1
NTCIP 1201 Amendment 2: 2007 - NTCIP Global Object Definitions Amendment 2
NTCIP 1203: 1997 - Object Definitions for Dynamic Message Signs (DMS)
NTCIP 1203 Amendment 1: 2001 - Object Definitions for Dynamic Message Signs (DMS) Amendment 1
NTCIP 1204: 1998 - Object Definitions for Environmental Sensor Stations
NTCIP 2101: 2001 - SP-PMPP/RS232 Subnetwork Profile
NTCIP 2104: 2003 - Ethernet Subnetwork Profile
NTCIP 2202: 2001 - Internet (TCP/IP and UDP/IP) Transport Profile
NTCIP 9011 – Guide on NTCIP Testing Certification
NTCIP 9012 – Testing Guide for User

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

DDNS: means Dynamic Domain Name Service.

DMS: means Dynamic Message Sign.

DMS Controller: means a general term for a sign controller for either a VMS or PVMS.

FSORS: means Full, Standardized Object Range Support. Means support for, and proper implementation of, all valid values of an object as defined within the object's OBJECT-TYPE macro in the subject NTCIP standard; this is further defined in two distinct sub-requirements. (1) If the ACCESS of the object is read-write, a Management System must be able to set the object to any valid value as defined by the SYNTAX and DESCRIPTION fields (except that the value of 'other' need not be supported when such a value is defined) and the indicated functionality must be provided. (2) The value indicated by the object (e.g., in response to a 'get'), regardless of the ACCESS, must reflect the current condition per the rules specified in the object's DESCRIPTION.

GPS: means Global Positioning System.

IP: means Internet Protocol.

Management System: means a computer system used to control an NTCIP component. This includes any NTCIP compliant local control software used for field control as well as the central control software.

NTCIP Component: means a DMS or a Management System.

NTCIP System: means a Management System and DMSs controlled by the Management System.

PVMS: means a Portable Variable Message Sign. Trailer mounted PVMS typically includes display elements, signcase, solar panels, photocell sensor, 1X or GPRS data modem, GPS receiver, electronic compass, batteries, battery enclosure, PVMS controller, controller enclosure, trailer and all associated mechanisms and equipment. Pole mounted PVMS typically includes display elements, signcase, solar panels, photocell sensor, 1X or GPRS data modem, batteries, battery enclosure, PVMS controller, controller enclosure, pole and all associated mechanisms and equipment. Pole mounted PVMS may also be connected to hydro power, dial-up telephone line or MTO COMPASS Ethernet LAN.

Response Time: means the time to prepare and begin transmission of a complete response containing the requested Application Layer information. This is measured as the time from receipt of the closing flag of the request to the transmission of the opening flag of the response when the device has immediate access to transmit.

TCP: means Transmission Control Protocol.

UDP: means User Datagram Protocol.

URL: means Universal Resource Locator.

VMS: means Variable Message Sign that typically includes sign structure, display elements, signcase, photocell sensor, DMS controller, and all other mechanisms and equipment.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall provide full documentation, including an electronic copy of all supported NTCIP and private vendor specific MIBs in ASN.1 notation. The electronic copy shall be in ASCII text and the syntax shall be verified with a 3rd party MIB complier. The Contractor shall provide written confirmation that all private vendor specific MIBs may be used by the Owner and distributed to the Owner’s agents for central software integration and testing activities.

5. MATERIALS

5.1 NTCIP Compliance

5.1.1 The DMS controller shall implement the most recent version of the standard that is at the stage of recommended or higher as of the time of procuring the signs, including any and all approved or recommended amendments to these standards as of the same date. In addition, if a standard or amendment referenced by this procurement has not yet achieved the status of recommended, the cited version shall prevail. Subsequent amendments or revisions to any document may be implemented pending the Owner’s approval. It shall be the responsibility of the Contractor to monitor NTCIP activities to discover and support more recent documents and amendments. The following is a list of applicable NTCIP documents:

a) NTCIP 1201
b) NTCIP 1201 Amendment 1
c) NTCIP 1201 Amendment 2
d) NTCIP 1203
e) NTCIP 1203 Amendment 1
f) NTCIP 1204
g) NTCIP 2101
h) NTCIP 2104
i) NTCIP 2202

5.1.2 The DMS controller shall provide Full Standardized Object Range Support (FSORS) of all objects required by this specification, unless otherwise indicated or approved by the Owner.

5.1.3 The maximum DMS controller Response Time for any object or group of objects shall be 200 milliseconds regardless to the subnetwork profile.

5.2 NTCIP 1201 Conformance

5.2.1 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Configuration Conformance Group. The DMS controller shall support the following minimum Configuration Conformance Group object ranges/values:

Object or Table Name	**Minimum Object Range/Values**
globalMaxModules	1
moduleTableEntry	
moduleMake	specify the name of manufacturer
moduleModel	specify the manufacture's name of the component
moduleVersion	indicate the model version number of the component
moduleType	software (3)

5.2.2 The sign controller shall optionally support all objects in the Global Database Conformance Group. If this group is implemented, the sign controller shall exclude all deprecated objects.

5.2.3 The sign controller shall implement and support all mandatory and specified optional objects contained in the Time Management Conformance Group. The DMS controller shall support the following minimum Time Management Conformance Group object ranges/values:

Object or Group Name	Minimum Object Range/Values
globalDaylightSaving	disableDST (2), enableUSDST (3)

5.2.4 The sign controller shall implement and support all mandatory and specified optional objects contained in the Time Base Event Schedule Conformance Group. The DMS controller shall support the following minimum Time Base Event Schedule Conformance Group object ranges/values:

Object or Group Name	Minimum Object Range/Values
maxTimeBaseScheduleEntries	7
MaxDayPlans	7
MaxDayPlanEvents	7

5.2.5 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Security Conformance Group. The DMS controller shall support the following minimum Security Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values	
	VMS	PVMS
communityNameAdmin	To be provided by owner	To be provided by owner
communityNameMax	4	4
communityNameTableEntry		
communityNameUser.1	To be provided by owner	To be provided by owner
communityNameAccessMask.1	To be provided by owner	To be provided by owner
communityNameUser.2	To be provided by owner	To be provided by owner
communityNameAccessMask.2	To be provided by owner	To be provided by owner
communityNameUser.3	To be provided by owner	To be provided by owner
communityNameAccessMask.3	To be provided by owner	To be provided by owner
communityNameUser.4	To be provided by owner	To be provided by owner
communityNameAccessMask.4	To be provided by owner	To be provided by owner

5.3 NTCIP 1203 Conformance

5.3.1 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Sign Configuration And Capability Conformance Group. The DMS controller shall support the following minimum Sign Configuration And Capability Conformance Group object ranges/values:

Object or Table Name	**Minimum Object Range/Values**	
	VMS	**PVMS**
dmsSignType	vmsFull (6)	portableVMSFull (134)
dmsBeaconType	none (2)	none (2)

5.3.2 The DMS controller shall implement and support all mandatory and specified optional objects contained in the GUI Appearance Conformance Group. The DMS controller shall support the following minimum GUI Appearance Conformance Group object ranges/values:

Object/Table Name	**Minimum Object Range/Values**
dmsSignTechnology	The utilized technology in a bitmap format.
dmsSignAccess	The utilized access method to the sign.
dmsSignHeight	The actual overall sign height in millimetres.
dmsSignWidth	The actual overall sign width in millimetres.
dmsHorizontalBorder	The actual horizontal border width in millimetres.
dmsVerticalBorder	The actual vertical border width in millimetres

5.3.3 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Font Definition Conformance Group. The DMS controller shall support the following minimum Font Definition Conformance Group object ranges/values:

Object/Table Name	**Minimum Object Range/Values**
numFonts	4
maxFontCharacters	255

5.3.4 The DMS controller shall implement and support all mandatory and specified optional objects contained in the VMS Configuration Conformance Group. The DMS controller shall support the following minimum VMS Configuration Conformance Group object ranges/values:

Object or Table Name	**Minimum Object Range/Values**
vmsSignHeightPixels	The actual number of rows of pixels for the entire sign.
vmsSignWidthPixels	The actual number of columns of pixels for the entire sign.
vmsHorizontalPitch	The actual horizontal distance from the centre of one pixel to the centre of the neighbouring pixel in millimetres.
vmsVerticalPitch	The actual vertical distance from the centre of one pixel to the centre of the neighbouring pixel in millimetres.

5.3.5 The DMS controller shall implement and support all mandatory and specified optional objects contained in the MULTI Configuration Conformance Group. The DMS controller shall support the following minimum MULTI Configuration Conformance Group object ranges/values:

Object or Table Name	**Minimum Object Range/Values**
defaultBackgroundColor	black (0)
defaultForegroundColor	amber (9)
defaultFlashOn	0 to 25
defaultFlashOff	0 to 25
DefaultFont	1 to 4
defaultJustificationLine	left(2), centre(3), right(4)
defaultJustificationPage	top(2), middle(3), bottom(4)
defaultPageOnTime	10 to 60
defaultPageOffTime	0 to 30
defaultCharacterSet	eightBit(2)

5.3.6 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Message Table Conformance Group. The DMS controller shall support the following minimum Message Table Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values	
	VMS	PVMS
dmsMaxChangeableMsg	64	20
dmsFreeChangeableMemory	131072 (when no changeable messages are stored)	20480 (when no changeable messages are stored)
dmsMaxVolatileMsg	64	20
dmsFreeVolatileMemory	131072 (when no volatile messages are stored)	20480 (when no volatile messages are stored)
dmsMessageEntry dmsMessageMemoryType	 permanent (2), changeable (3), volatile (4), currentBuffer (5), schedule (6)	 permanent (2), changeable (3), volatile (4), currentBuffer (5), schedule (6)

5.3.7 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Sign Control Conformance Group. The DMS controller shall support the following minimum Sign Control Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
dmsControlMode	local (2), central (4), and centralOverride (5)
dmsSWReset	0, 1
dmsMessageTimeRemaining	0 to 65535
dmsMsgSourceMode	local (2), central (8), timebasedScheduler (9), powerRecovery (10), reset (11), commLoss (12), powerLoss (13), endDuration (14)
dmsMemoryMgmt	normal (1), clearChangeableMessages (2), clearVolatileMessage (3)

5.3.8 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Default Message Conformance Group. The DMS controller shall support the following minimum Default Message Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
DmsShortPowerRecoveryMessage	Blank message
DmsLongPowerRecoveryMessage	Blank message
DmsShortPowerLossTime	0 to 120
DmsResetMessage	Blank message
dmsCommunicationsLossMessage	Blank message
DmsTimeCommLoss	0 to 1440
DmsPowerLossMessage	Blank message
DmsEndDurationMessage	Blank message

5.3.9 The DMS controller shall implement and support all mandatory and specified optional objects contained in the MULTI Error Conformance Group. The DMS controller shall support the following minimum MULTI Error Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
DmsMultiSyntaxError	other (1), none (2), unsupportedTag (3), unsupportedTagValue (4), textTooBig (5), fontNotDefined (6), characterNotDefined (7), fieldDeviceNotExist (8), fieldDeviceError (9), flashRegionError (10), tagConflict (11), tooManyPages (12)
dmsMultiSyntaxErrorPosition	0 to 65535
dmsMultiOtherErrorDescription	Vendor-specified error message text descriptions

5.3.10 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Illumination/Brightness Conformance Group. The DMS controller shall support the following minimum Illumination/Brightness Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
DmsIllumControl	photocell (2), manual (4)
dmsIllumMaxPhotocellLevel	10
dmsIllumPhotocellLevelStatus	0 to 10
dmsIllumNumBrightLevels	10
dmsIllumBrightLevelStatus	0 to 10
DmsIllumManLevel	0 to 10
dmsIllumBrightnessValuesError	other (1), none (2), photocellGap (3), negativeSlope (4), tooManyLevels (5), invalidData (6)
dmsIllumLightOutputStatus	0 to 10

5.3.11 The DMS controller shall implement and support all mandatory objects contained in the Scheduling Conformance Group.

5.3.12 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Sign Status Conformance Group. The DMS controller shall support the following minimum Sign Status Conformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
WatchdogFailureCount	An ASN.1 counter indicating the number of watchdog failures that have occurred
dmsStatDoorOpen	If the signcase contains a walk-in service door, this object values shall be 0 when closed and 1 when open. If the signcase does not contain a walk-in service door, this object value shall always be set to 0.

5.3.13 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Status Error SubConformance Group. The DMS controller shall support the following minimum Status Error SubConformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
shortErrorStatus	Bit 0- other error, Bit 1- communications error, Bit 2- power error, Bit 5- pixel error, Bit 6- photocell error, Bit 7- message error, Bit 8- controller error. If the DMS is supplied with a GPS reader and/or electronic compass, should one or both of these devices fail in any way, Bit-3- attached device error shall be set. If the signcase utilizes cooling fan(s), then upon any fan(s) failure Bit 10- fan error shall be set.
controllerErrorStatus	Bit 0- other error, Bit 1- PROM error, Bit 2- program/processor error, Bit 3- RAM error

5.3.14 The DMS controller shall implement and support all mandatory and specified optional objects contained in the Pixel Error SubConformance Group. The DMS controller shall support the following minimum Pixel Error SubConformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
PixelFailureEntry pixelFailureStatus	 Bit 2 - electrical error.
pixelTestActivation	noTest (2), test (3), and clearTable (4)

5.3.15 If the VMS/PVMS signcase utilizes cooling fan(s), then the DMS controller shall implement and support all mandatory and specified optional objects contained in the Fan Error Status SubConformance Group. The DMS controller shall support the following minimum Fan Error Status SubConformance Group object ranges/values:

Object or Table Name	Minimum Object Range/Values
fanFailures	Upon any signcase cooling fan(s) or fan system failure, Bit 0 shall be set.
fanTestActivation	noTest (2), test (3)

5.3.16 If the VMS/PVMS is supplied with a solar/battery power source, then the DMScontroller shall implement and support all mandatory and specified optional objects contained in the Power Status SubConformance Group. The DMS controller shall support the following minimum Power Status SubConformance Group object ranges/values:

Object or Table Name	**Minimum Object Range/Values**
signVolts	Measured battery power source voltage in units of hundredth (1/100) of a DC volt.
powerSource	acLine (4) and battery (7)

5.3.17 The DMS controller shall implement and support the following NTCIP 1203 MULTI tags:

MULTI Tag Definition	**Description**
cbx	Color-background
cfx	Color-foreground
[fl], [fltxoy], and [/fl]	Flash text within a line
[fox]	Select a font number from the font table
[hcx]	Hexadecimal Character
[jlx]	Line justification
[jpx]	Page justification
[nlx]	New line
[np]	New page
[ptxoy]	Page time
[scx] and [/sc]	Spacing between characters
Mvtdw,s,r,text	Moving Text

The DMS controller shall implement and support the following MULTI tags per NTCIP recommended version V2.35 to support colour and graphic display.

MULTI Tag Definition	Description
pbz or pbr,g,b	Color – page background
crx,y,w,h,r,g,b or crx,y,w,h,z	Color Rectangle
gn or gn,x,y or gn,x,y,cccc	Graphic
trx,y,w,h	Text Rectangle

5.4 NTCIP 1204 Conformance

5.4.1 If the VMS/PVMS is supplied with a GPS reader and/or electronic compass, then the DMS controller shall implement the specified Environmental Sensor Stations objects and shall support the following minimum object ranges/values:

Object or Table Name	Minimum Object Range/Values
essLatitude	If VMS/PVMS is supplied with a GPS reader, the current GPS reader latitude in 10^-6 degrees: -90000000 to 90000001
essLongitude	If VMS/PVMS is supplied with a GPS reader, the current GPS reader longitude in 10^-6 degrees: -180000000 to 180000001
essVehicleBearing	If VMS/PVMS is supplied with a electronic compass, the current electronic compass bearing in degrees: 0 to 360

5.5 NTCIP 2101 Conformance

5.5.1 The PVMS controller shall conform to all mandatory SNMP Application Profile and SP-PMPP/RS232 Transport Profile requirements specified. Responses must use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

5.5.2 All optional Point to Multi-Point Subnetwork Profile requirements may be supported.

5.6 NTCIP 2104 Conformance

5.6.1 The DMS controller shall conform to all mandatory Ethernet Subnetwork Profile requirements specified. Responses must use the same Application Profile used by the request. Each NTCIP Component shall support the receipt of Application data packets at any time allowed by the subject standards.

5.6.2 All optional Ethernet Subnetwork Profile requirements may be supported.

5.7 NTCIP 2202 Conformance

5.7.1 The DMS controller shall conform to all mandatory Internet (TCP/IP and UDP/IP) Transport Profile requirements specified. Response datagrams must use the same Transport Profile used in the request. Each NTCIP component shall support the receipts of datagrams conforming to the DMS configured TCP/IP or UDP/IP Transport Profiles.

5.7.2 All optional Internet (TCP/IP and UDP/IP) Transport Profile requirements may be supported.

5.8 MTO Graphics Conformance

5.8.1 In accordance with the recommended version 2.35 of NTCIP 1203, the Contractor shall provide the following objects.

The DMS controller shall implement and support all mandatory and optional specified objects contained in the Graphic Conformance Group. The DMS controller shall support the following minimum Graphic Group object ranges/values. All additional and/or private MIBS required to support the MTO Graphics Conformance functions shall be documented in ASN.1 format and submitted to the MTO for approval prior to implementation.

Object or Table Name	**Minimum Object Range/Values**
dmsGraphicMaxEntries	0 to 255
dmsGraphicMaxSize	0 to 65535
availableGraphicMemory	Counter
dmsGraphicBlockSize	0 to 65535
dmsGraphicTable	
dmsGraphicIndex	1 to 255
dmsGraphicNumber	1 to255
dmsGraphicname	DisplaySring size 0 to 64
dmsGraphicHeight	1 to 255
dmsGraphicWidth	1 to 65535
dmsGraphicType	Color24bit(4)
dmsGraphicID	0 to 65535
dmsGraphicTransparentEnabled	0 to 1
dmsGraphicTransparentColor	Octet String

Object or Table Name	Minimum Object Range/Values
dmsGraphicStatus	Notused(0) modifying(1) calculatingID (2) readyForUse (4) inUse(5) permanent(6) modifyReq(7) readyForUseReq(8) notUseReq(9)
dmsGraphicBitmapTable	
dmsGraphicBitmapIndex	1 to 255
dmsGraphicBlockBitmap	Octet String

*Designer Fill-in – See Notes to Designer

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The NTCIP protocol shall be inherent to the VMS/PVMS and DMS controller.

7.2 The Contractor shall configure and install the Owner supplied extended ASCII bilingual variable width font as the default non-volatile NTCIP font number 1.

7.3 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.3	√ [1]		
5.2.1	√ [1]		
5.2.2	√ [1]		
5.2.3	√ [1]		
5.2.4	√ [1]		
5.2.5	√ [1]		
5.3.1	√ [1]		
5.3.2	√ [1]		
5.3.3	√ [1]		
5.3.4	√ [1]		
5.3.5	√ [1]		

CLAUSE	PIT	POP	SIT
5.3.6	√ [1]		
5.3.7	√ [1]		
5.3.8	√ [1]		
5.3.9	√ [1]		
5.3.10	√ [1]		
5.3.11	√ [1]		
5.3.12	√ [1]		
5.3.13	√ [1]		
5.3.14	√ [1]		
5.3.15	√ [1]		
5.3.16	√ [1]		
5.3.17	√ [1]		
5.4.1	√ [1]		
5.5.1	√ [1]		
5.6.1	√ [1]		
5.7.1	√ [1]		
5.8.1	√ [1]		

**Designer Fill-in – See Notes to Designer

Testing Footnotes:

[1] An independent party, other than the DMS manufacturer, shall perform all NTCIP testing. The independent party must have conducted at least 3 previous DMS NTCIP tests in North America. The references must be submitted at least 3 weeks in advance of the PIT testing. The independent party shall conform to the latest 9011 and 9012 NTCIP standards for testing. NTCIP test procedures shall be submitted at least 3 weeks prior to each test and are subject to the Owner's satisfaction and approval. The Contractor must provide the Owner with a certificate of NTCIP compliance for NTCIP standards 1201, 1203, 1204 (applicable), 2101, 2104, and 2202.

The test results shall include both a hard copy print out and a CD containing electronic ASCII text file(s) of all object parameter values. It shall be confirmed that each mandatory and required optional object is set to its correct value.

8. QUALITY ASSURANCE – Not Used

NOTES TO DESIGNER:

* Include the following when the signs are to have colour capability:

5.9 MTO Colour Conformance

5.9.1 In accordance with the recommended version 2.35 of NTCIP 1203 version 2.35, the Contractor shall provide the following objects.

The DMS controller shall implement and support all mandatory and optional specified objects contained in the Colour Conformance Group. The DMS controller shall support the following minimum Graphic Group object ranges/values. All additional and/or private MIBS required to support the MTO Colour Conformance functions shall be documented in ASN.1 format and submitted to the MTO for approval prior to implementation.

Object or Table Name	**Minimum Object Range/Values**
characterBitmap	Octec String
defaultFroregroundRGB	Octec String
defaultBackgroundRGBActivate	Octec String
defaulBackgroundRGB	Octec String
defaultForegroundRGBActivate	Octec String
dmsColorScheme	Color24bit(4)
dmsSupportedMultiTags	Octec String

** Add clause 5.9.1 to the table for PIT process validation when clause 5.9 MTO Colour Conformance above is included.

WARRANT: Always with the items:

- Variable Message Signs
- Portable Variable Message Signs, Trailer Mounted
- Fixed Support Mountable Variable Message Signs

<u>BOLLARDS</u> - Item No.

Special Provision No. 599S27 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation of bollards.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 603 Installation of Ducts

Ontario Provincial Standard Specifications, Material:

OPSS 1350 Concrete – Materials and Production

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS – Not Used

5. MATERIALS

5.1 Pipe

Galvanized steel pipe shall meet the requirements of OPSS 603 for steel conduit.

5.2 Concrete

Concrete shall meet the requirements of OPSS 1350, 30 MPa class.

5.3 Reflective Tape

Reflective tape shall be non-metallic 6-inch Engineering Grade (Type I) Safety Reflective Tape in yellow colour.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

Bollards shall be installed plumb and at the same height as indicated in the Contract Drawings and marked with a reflective tape following the placement. Three tape stripes shall be placed starting at the top with 100mm separation between each stripe.

7.1 Quality Control

The Contractor shall inspect the work to ensure that it complies with the requirements of the Contract including placement of bollards with respect to the cabinet pad and roadside barrier, plumb position, sufficient concrete fill and application of the reflective tape on bollards.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of bollards is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including earth excavation, concrete work and backfilling.

WARRANT: Always with this item.

<u>TRAINING FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK</u> - Item No.

Special Provision No. 681F15 September 2007

1. SCOPE

This Special Provision covers the requirements for training seminars to be provided by the Contractor. The seminars shall be carried out at a site within Central Region to be provided by the Owner.

The training shall be provided in two stages: first – 30 days following completion of Phase I of the Contract and second – 6 months prior to completion of Phase II of the Contract.

The training shall be provided for the following equipment supplied under this Contract: *

ITEM DESCRIPTION	ITEM SPEC. CODE

Two types of seminars shall be provided:

a) An overview/introductory level briefing to familiarize attendees with the equipment, its installation, operation and maintenance;

b) A technician level course covering electronics and communications equipment.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION AND REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit a seminar outline and list of materials to be demonstrated for review by the Contract Administrator a minimum of 6 weeks in advance of the proposed first stage course date(s). The Contract Administrator will review the course material or content within 3 weeks of receipt. The Contractor shall allow adequate time for reviews and revisions to ensure the courses are held within the designated dates.

The second stage training documentation shall be identical to the first and shall be submitted to the Owner a minimum of 3 weeks in advance of the proposed training date(s).

5. MATERIALS

Each training participant shall receive a copy of the approved course material. This requirement applies for both training stages. Where additional selected pages are desirable, the Owner shall provide photocopying services. The Contractor shall release the Owner of any copyright infringements for these purposes.

The course material shall include copies of both a comprehensive manual and of the presentation material that will be used for all trainees. Two additional hard copies and one soft copy on a single CD shall be provided to the Contract Administrator within two weeks of the first stage training.

All training material shall be turned over to the Owner after completion of each stage of the training.

6. EQUIPMENT

The Owner will provide basic seminar equipment such as VGA projectors, overhead projectors, screens, VCRs, etc.

The Contractor shall provide any additional audio-visual aids and equipment for "hands on" demonstration which is considered necessary for effective presentation of the seminar contents.

For each stage of training, the Contractor shall supply a minimum of two sets of any special tools, diagnostic software installations CDs and applicable licenses and all other equipment required for training.

7. CONSTRUCTION

The overview/introductory level briefing for operations, engineering and maintenance shall be a minimum half-day in duration.

The technician level course shall include relevant topics in electronics and communications, a detailed description and explanation of the theory of operation of major components including hardware and software, operating procedures, diagnostics and maintenance to the replaceable module level, use of test equipment and diagnostic tools, installation and alignment techniques. The technician level course shall also show how to use the system documentation to operate, diagnose, maintain and expand the system. Furthermore, the technician level course shall involve the "hands-on" use of the system, system test equipment and Contractor supplied equipment. This seminar is expected to be attended by the Owner’s electronic technologist / maintenance personnel.

The duration of the technical seminar shall be **______days.

A total of ***______ personnel will be trained for each seminar.

Instructors shall be technically knowledgeable, competent and proficient in the English language. A member of the Contractor’s staff having intimate experience with this Contract shall attend the courses and provide answers to any inquiries.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, equipment and materials required to do the Work.

Interim payments shall be made as follows:

<u>Upon Acceptance of:</u> <u>Value:</u>

Training program and materials	20%
Completion of stage I	40%
Completion of stage II	40%

The holdback of payments will not apply to Phase II work.

NOTES TO DESIGNER:

*   Fill-in table size is reduced. Add rows as required.

**   Number of days for seminar to be assessed and filled in. Minimum is 0.5 days.

***   Consult with ATMS Project Manager regarding number of attendees for course, minimum of 10.

WARRANT: Always with this item.

<u>SPARE COMPONENTS FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK</u> - Item No.

___

Special Provision No. 681F17 September 2007

1. SCOPE

This Special Provision covers the requirements for the supply of additional quantities of tender items in accordance with the requirements of the Contract. The work shall include Pre-installation Testing and delivery.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit a unit price breakdown for all spare component items to the Contract Administrator upon approval of Material Selection Documentation.

5. MATERIALS

The Contractor shall supply the following spare components ten days before completion of the Contract:

ITEM DESCRIPTION	UNIT	QUANTITY	ITEM SPEC. CODE
*			

The above items shall be supplied in accordance with the Contract Documents.

Products provided as spare components shall be of uniform style and manufacture, shall match the components used in the Contract in all respects.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

All spare components shall undergo full Pre-Installation Testing (PIT) as detailed in the Special Provision for the applicable item prior to delivery. This work shall include documentation for all test results.

The Contractor shall deliver equipment designated as spare components to the location designated by the Contract Administrator. The location shall be **________________________. Delivery shall be made between 7:00 am and 3:00 pm E.S.T., Monday to Friday, except for statutory holidays.

The Contractor shall notify the Contract Administrator 24 hours in advance of intended delivery times. The equipment shall be packed in appropriate shipping containers to prevent damage during shipping.

The Contractor shall supply a packing slip with the delivery listing contents of the shipment. If shipment does not include all items listed as spare components, the Contractor shall provide a summary of items delivered, items outstanding and estimated timing of the delivery.

8. QUALITY ASSURANCE - Not Used

9. MEASUREMENT FOR PAYMENT - Not Used

10. BASIS OF PAYMENT

Payment at the Contract price shall be full compensation for all labour, Equipment and Materials to do the work.

The Owner reserves the option of deleting the Contractor's requirement to supply any particular spare component, without impacting the unit price as established for other spare components.

The Owner reserves the option of adjusting the required quantity of any particular spare component by not more than plus or minus twenty percent without impacting the unit price as established for that particular spare component.

NOTES TO DESIGNER:

* Complete list must be filled in under Section 5 in consultation with the ATMS Office. Fill-in table size is reduced. Add rows as required.

** Fill-in the delivery location.

WARRANT: Always with this item.

SYSTEM INTEGRATION TESTING FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.

Special Provision No. 681F19 September 2007

1. SCOPE

This Special Provision covers the requirements for System Integration Testing (SIT) of all ATMS subsystems associated with the Work.

2. REFERENCES - Not Used

3. DEFINITIONS - Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit documentation of the Systems Integration Testing Procedures and Systems Integration Testing Report for approval. All documentation shall meet the requirements stipulated elsewhere in the Contract.

The Contractor shall submit a 14-day burn-in test plan to the CA for approval two weeks prior to commencing the 14-day burn-in.

The Contractor shall submit documentation of the successful completion of PIT, POP and Stage 1 of SIT, along with notification of the schedule date of the 14-day burn-in to the Contract Administrator a minimum of five business days prior to scheduled commencement of Stage 2 SIT.

5. MATERIALS - Not Used

6. EQUIPMENT

The Contractor shall provide all test equipment for the System Integration Tests. The Owner will provide 120 volt power at the field cabinets and at the TOC.

7. CONSTRUCTION

7.1 Liability

The Contractor is responsible for the proper and harmonious operation of all subsystems, which the Contractor installs. Where connection to existing subsystems or components of existing subsystems are required, the Contractor is responsible for connection of equipment specified in the Contract and for elementary system integration tests. Such Work will be carried out under the direction of the Contract Administrator.

7.2 STAGE 1

The Contractor shall carry out tests in the following chronological order:

a) Complete all equipment and subsystem tests required in the Contract;
b) Test each subsystem independently on the communications subsystem;
c) Test each subsystem independently through the communications subsystem with the head end control device in the TOC;
d) Add subsystems one at a time and monitor the head end performance at the TOC;
e) Fail safe testing of all subsystems one at the time and monitor the head end performance at the TOC.

The Contractor shall not be permitted to commence Stage 2 until Stage 1 has been performed and successfully completed and all documentation of the successful completion of PIT, POP and Stage 1 of SIT, along with notification of the schedule date of the 14-day burn-in is provided to the Contract Administrator in accordance with the requirements of this Special Provision. Commencement of Stage 2 will be conditional on the Contract Administrator verifying that PIT, POP and Stage 1 of SIT were successfully completed and the Contractor receiving a written notification of Owner’s readiness to proceed to Stage 2.

7.2.1 Integration Tests Required

The integration tests shall be carried out between the following subsystems:

a) Loops in pavement with Controller Units and Controller Cabinets;
b) Controller Units with the Communications Subsystem head ended by the data node modules and VDS computer;
c) CCTV cameras, pan / tilt units, digital video encoders, and/or controller units with the Communications Subsystem head ended by the digital video decoders, video receiver modules, camera control transmitter (CCT), the video switcher and/or the video display system;
d) VMS and VMS Controller Unit with the Communications Subsystem head ended by the data node modules and VMS computer;
e) Communications subsystem including all Ethernet switches, modems, node modules, multiplexer/de-multiplexers, digital video encoders/decoders, modulators/demodulators, port servers, transmitters and receivers, and auxiliary equipment with all other exterior subsystems;
f) ____
g) ____
h) ____

System integration testing required for each applicable Contract item is to be carried out as specifically addressed under the heading "SIT" in the testing requirements table for that item.

In addition, the Contractor shall perform the following tests:

Loopback in the Field

For serial communications:

A data test set shall be connected to the appropriate Data Channel Port at the TOC CDIN. At each field modem, isolated channels shall be used for testing the receive data (RD) line shall be looped to the transmit data (TD) line using an appropriate test connector. A random or pseudo- random sequence of data bits shall be transmitted to the field at an asynchronous data rate of 9600 bps. Return data from the field shall be recorded and compared with that transmitted to determine the bit error rate. Data shall be burst and continuous.

The bit error rate shall not exceed 10^{-7} for each loopback test.

Loopback at Central

At the appropriate Data Channel Port at the TOC CDIN the receive data (RD) line shall be looped to the transmit data (TD) line using an appropriate test connector. At each field modem a data test set shall be connected. A random or pseudo- random sequence of data bits shall be transmitted to Central at an asynchronous data rate of 9600 BPS. Return data from Central shall be recorded and compared with that transmitted to determine the bit error rate. Data shall be burst and continuous.

The bit error rate shall not exceed 10^{-7} for each loopback test.

7.3 STAGE 2

The Contractor shall submit the schedule for this stage to the Contract Administrator 5 Working days before the scheduled start date. The Contract Administrator shall modify the schedule if necessary to avoid conflict with other MTO activities.

The Contractor shall conduct a 14-day burn-in test for all equipment. The burn-in period for all equipment shall begin when all subsystems are added to the system and with the permission of the Contract Administrator.

7.4 Failure of Tests

Where equipment supplied by the Contractor fails during the burn-in period, the Contractor shall restart the test at Day 0 (zero) following appropriate corrective measures. No compensation will be made for repeat testing under these circumstances.

If a utility power failure is proved to be the cause of testing failure, then the Contractor shall restart the Stage 2 test at the day the failure occurred. If a subsystem failure is proved to be the cause of testing failure, then the Contractor shall start the test over at Day 0 (zero).

Where tests or burn-in indicate that an existing subsystem or component is defective, the Contractor shall immediately report the deficiency to the Contract Administrator. The Contract Administrator may assign corrective repairs, retesting and repeat of burn-in to the Contractor, in accordance with Change Order provisions of the MTO General Conditions of Contract.

The Contractor shall be suitably prepared for Stage 2 prior to the Stage 2 start date. Repeated failure of Stage 2 may be considered a major deviation by the Contractor Administrator.

The Contractor shall provide the Contract Administrator with a contact name and phone number(s) for a designated emergency contact person during Stage 2. The emergency contact person shall be accessible 24 hour a day, for each day of Stage 2 testing.

8. QUALITY ASSURANCE - Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment at the Contract price shall be full compensation for all labour, Equipment and Materials required to do the work.

Where defects in the performance of the Owner's existing subsystems or components are found, the existing systems shall be repaired as directed by the Contract Administrator and shall be administered under the Change Order provisions of the MTO General Conditions of Contract.

The Contract price for this item shall not be less than *______% of the total tender value of ATMS items as defined below:

ITEM DESCRIPTION	**ITEM SPEC. CODE**

NOTES TO DESIGNER:

1. Add to or delete from Section 7.2.1 as required.

2. Choose applicable items from Chapter B of the ATMS CDED Manual and any other items as may be requested by the ATMS project manager for filling in Section 10. Fill-in table size is reduced. Add rows as required.

* Fill-in percentage of minimum % of selected items.

WARRANTS:
1. Any Contract where more than one subsystem is constructed.
2. Any Contract where equipment is added to an existing subsystem.

MAINTENANCE AND WARRANTY FOR ADVANCED TRAFFIC MANAGEMENT SYSTEM WORK - Item No.

Special Provision No. 681F25 September 2007

1. SCOPE

This Special Provision covers the requirements for Maintenance and Warranty for all ATMS components supplied or modified under this Contract.

2. REFERENCES – Not Used

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Critical Failure: means any failure that may compromise public safety such as malfunction of VMS, QWS or RMS or failure related to the high speed data transmission equipment or cable plant which causes substantial communications loss, or the failure of any video multiplexer, or the failure of route diversity capabilities or the failure of system components such that system operations are degraded substantially.

Emergency Repairs: means any activity required to bring the Subsystem to full functionality in accordance with the specifications other than Routine Maintenance activities.

Equipment: means all electrical or mechanical devices and vehicles used or reasonably required for use in Emergency Repairs or Routine Maintenance of the System Components.

Routine Maintenance: means ongoing preventive maintenance activities in accordance with the manufacturer's recommendations and in accordance with the System Components Maintenance and Service Manuals and includes the periodic adjustment of System components to correct deviations from System specifications resulting from normal operation of the System.

Special Tools: Special tools required for carrying out maintenance activities such diagnostic equipment, custom tools, software, etc.

System Components: means all hardware and software components, devices, parts and materials included in the ATMS System or Subsystem supplied, installed, modified or replaced under Phase I including all spare parts supplied by the Contractor.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

Two weeks prior to anticipated acceptance of Phase I of the Contract, the Contractor shall submit a letter of intent indicating his readiness to proceed to Phase II of the Contract and the intention to submit the letter of credit. The letter of intent shall indicate the name of financial institution that will issue the letter of credit. At Contractor's request, the Contract Administrator may provide a sample letter of credit.

The Contractor shall provide upon the date of acceptance of Phase I of the Contract an irrevocable letter of credit payable to the Minister of Finance in the amount of 100% of the Contract price for the Maintenance and Warranty Contract item. This letter of credit shall constitute a guarantee of performance and shall be returned to the Contractor one month following the completion of Phase II except in the event of non-performance. In the event of non-performance the letter of credit shall be drawn upon by the Owner as required to pay for services which were not performed by the Contractor in excess of the value of the Maintenance and Warranty Contract item.

The letter of credit shall be issued by a Canadian Chartered Bank or Financial Institution, as approved by the Owner and shall have offices to administer such Letter of Credit within the following geographical area:

* ______________________________

The Letter of Credit shall be provided to Owner within 5 business days of achieving acceptance of Phase I.

5. MATERIALS

Two sets of any special tools required to carry out maintenance work shall be supplied by the Contractor within 10 business days of start of Phase II.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Duration

The duration of Phase II shall be 1826 consecutive calendar days following the date of acceptance of Phase I.

7.2 Operational Constraints (Traffic Control)

The Contractor shall follow all operational constraints established by the Owner for traffic control when performing Routine Maintenance and Emergency Repairs.

Should lane closures be necessary during Routine Maintenance the Contractor shall provide written notice of its requirements to the Owner at least 72 hours in advance of the start of the work. The Contractor shall follow the lane closure notification procedures established by the Owner.

Should lane closures be required during Emergency Repairs they shall be carried out according to the procedures provided by the Owner.

7.3 Warranty

The warranty shall cover any defects in materials and workmanship for all System Components. Any replacements required during Phase II shall be made without additional charge for labour, equipment, materials and system components.

The Contractor shall be the warrantor of all System Components notwithstanding any supplier's warranties whether written or implied.

Any System Component returned for repair or replacement under warranty during Phase II shall be repaired or replaced with identical or 100% compatible System Component and returned to the Owner within sixty (60) days.

7.4 Maintenance

The Contractor shall maintain all System Components in good working condition in accordance with the Contract specifications and shall provide all Routine Maintenance and Emergency Repairs required to carry out this obligation.

Routine Maintenance shall comply with the manufacturer's recommendations and be in accordance with the Subsystems components Operations and Maintenance Manuals.

One month prior to commencement of Phase II, the Contractor shall identify in writing the procedures and schedule for Routine Maintenance and submit this procedure and schedule to the Contract Administrator for review.

One month prior to commencement of Phase II, the Contractor shall provide on call local emergency repair service and such service shall be available 24 hours a day 7 days a week for the full 1826 day duration of Phase II. Emergency repairs shall be required whenever there is a failure or cessation of operation of any component(s) of the ATM System.

Routine maintenance shall include seasonal adjustments of advanced traffic management system equipment as detailed in the Contract Documents.

During the Maintenance and Warranty period, the Contractor shall enter a precise description of work performed into the log book (located on site). The description of work performed shall include the following:

a) logging the component or module failure;
b) logging the serial number of failed module and replacement part, if applicable;
c) logging the corrective action performed;
d) logging of recommended preventive measures that may reduce or prevent similar failures, if applicable.

7.5 Response, Notification and Restoration

One month prior to commencement of Phase II, the Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Owner. The Owner will designate representatives and alternates as contact persons for the Traffic Operations Centre (TOC) and the field equipment and provide this information to the Contractor.

The Contractor shall liaise with the Owner's maintenance personnel and shall notify the designated Owner representative or alternate prior to undertaking any Routine Maintenance or Emergency Repairs. The Owner's staff shall have the option to accompany the Contractor's staff when Routine Maintenance or Emergency Repairs are carried out. The Contractor shall record all entries into field cabinets and the TOC in the log books provided by the Owner.

The Contractor shall respond to Emergency Repair calls by the Owner or the designated alternate. The time taken by the Contractor to reach the site of the malfunction and commence repairs following notification of a need for Emergency Repairs shall:

a) not exceed four hours for non-critical failures.

b) be immediate and not exceed two hours at any time for Critical Failures.

For Non-Critical failures the Contractor shall have 24 hours from the time of receipt of notification of a defect to restore the subsystems to a full functional condition meeting all requirements of the Specifications.

Critical Failures shall be restored to a full functional condition meeting all requirements of the specifications and to the satisfaction of the Owner's representative within twelve hours of notification of the failure.

7.6 Replacement of System Components

System Components required to perform Routine Maintenance and Emergency Repairs may, at the option of the Contractor, be obtained from the inventory of spare System Components supplied by the Contractor under Phase I of the Contract except that where a component fails under ordinary operating conditions and insufficient or no spare components were provided under Phase I of the Contract, the Contractor shall supply the replacement components.

One month prior to commencement of Phase II of the Contract, the Contractor shall supply a proposed price list for major systems components (those covered by individual tender items, plus those listed as being supplied as spare components), a detailed maintenance schedule, a list of labour rates and a list of equipment rates for any equipment not covered by OPSS 127 which would be in effect throughout Phase II. The Contract Administrator shall review these prices and rates prior to the date of acceptance of Phases I of the Contract.

The Contractor shall, prior to acceptance of Phase II of the Contract, supply all components required to replenish the Owner's stock of spare components to the full requirements stated for Phase I without additional payment.

7.7 Phase II Final Inspection

The Contractor shall arrange, with the Owner, a final Warranty inspection two months prior to the date of acceptance of Phase II of the Contract. The two parties shall inspect the all System Components to verify their physical condition and operation.

For Variable Message Signs the inspection shall include the sign display while all display elements are being exercised with an alternating test pattern (25% of pixels on) in various brightness modes. The test pattern shall be run for a sufficient period of time in order to inspect the following items:

a) All display elements and sub-systems shall be shown to be working properly within their specified ranges. The Contractor shall immediately replace any defective components;

b) All display elements shall be verified to exhibit consistent luminous output from pixel to pixel throughout the entire sign. The luminous consistency shall be verified in all brightness modes. The Contractor shall replace all display elements which in the opinion of the Contract Administrator do not meet this requirement;

c) All display elements shall be verified to exhibit consistent <u>intensity</u> from pixel to pixel throughout the entire sign. The colour consistency shall be verified in all brightness modes.

The Contractor shall replace all system components noted as deficient prior to acceptance of Phase II.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Except in cases of damage caused by others the Contractor shall provide all labour, Equipment and Materials required to carry out the repair at his expense. In the event the Subsystem or any component thereof is damaged as a result of the acts or omissions by others, including employees of the Owner, other Contractors, users of the highway or trespassers, the Contractor shall carry out Emergency Repairs or component replacement forthwith as Extra Work in accordance with MTO General Conditions of Contract.

Payment at the Contract price shall be full compensation for all labour, Equipment, Materials and services required to provide Maintenance and Warranty during Phase II. The Contract price for this item shall be not less than ** ______ % of the total tender value of ATMS items as defined below: ***

ITEM DESCRIPTION	ITEM SPEC. CODE

Payment will be made quarterly or as otherwise agreed with the Owner. Payment will be calculated by dividing the total Contract price for this item by 20. Final payment for this Contract item and the return of the Letter of Credit shall occur at the end of Phase II plus one month provided the subsystem is fully operational and performing according to Contract Specifications and all spare system components taken from the Owner's inventory by the Contractor to carry out Routine Maintenance and Emergency Repairs have been replaced in good working condition. The holdback of payments will not apply to Phase II work.

10.1 Default

Each time the Contractor fails to respond to a request for Emergency Repairs within the time limits specified in this Special Provision, the Owner's representative or alternate shall record the amount of time which elapses between the end of the specified response time and the time of actual response.

The Contractor shall be sent notice of non-performance in the event that:

a) the total number of hours of delay in any given seven day period exceeds 8 hours for response and restoration; or

b) the subsystem or any portion of it is not available for use or not operating according to the Contract Specifications for a period of one month or more; or

c) the total number of hours of delay exceeds 8 hours per month for 3 consecutive months; or

d) the response times are exceeded twice for non-critical failures within any seven day period; or

e) the response times are exceeded once for critical failures within any seven day period; or

f) the restoration time is exceeded twice within any seven day period.

The Contractor shall also be in default if he fails to provide Routine Maintenance in accordance with the procedures and schedules approved by the Contract Administrator.

In the event the Contractor does not remedy the non-performance within 30 days of notification of non-performance, the Owner will deal with the Contractor in accordance with the MTO General Conditions of Contract and draw upon the letter of credit as required to recover the additional costs it incurs as a result of the Contractor's default.

NOTES TO DESIGNER:

* Identify the geographical area within which financial institution should be located.

** Fill in the percentage of minimum % of selected items.

*** Fill out the applicable items as contained in the Contract. Fill-in table size is reduced. Add rows as required.

WARRANT: Always with this item.

<u>GROUND DEPLOYMENT OF PORTABLE VARIABLE MESSAGE SIGNS</u> - Item No.
<u>FIXED SUPPORT DEPLOYMENT OF VARIABLE MESSAGE SIGNS</u> - Item No.

Special Provision No. 681F32 September 2007

1. SCOPE

This Special Provision covers the requirements for deployment of the Portable Variable Message Signs (PVMS), supplied by the Owner or under a separate Contract item, at locations specified by the Owner. The ground deployment may include the following scenarios:

a) Ground trailer deployment;
b) Trailer on wooden crib deployment;
c) Deployment requiring a crane to enable installation over roadside barriers or other obstructions.

Fixed support deployment shall include but not be limited to lifting equipment and traffic control required to complete the sign installation.

2. REFERENCES – Not Used

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Deployment Area: means the geographic area that encompasses the following Regions or Counties: *____.

Deployment Work Order: means standard form issued by the Owner to the Contractor specifying deployment of a Portable Variable Message Sign (PVMS) including deployment location, identifying current location of the sign and deadline for completion of the work.

Equipment: means all electrical or mechanical devices and vehicles used or reasonably required for use in Emergency Repairs or Routine Maintenance of the System Components.

4. DESIGN AND SUBMISSIONS REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit a request for approval to the Owner for any deployment requiring the construction of a crib or the use of a crane.

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Operational Constraints - Traffic Control

The Contractor shall assess traffic control and lane closure requirements, site access, equipment requirements and any preparatory activities that may have to be completed prior to delivery of the sign to the site.

The Contractor shall follow the requirement of OTM Book 7 for traffic control during deployment activities.

The Contractor shall follow the current procedures for Right-of-Way (ROW) usage and traffic lane closure request as established by the Owner.

7.2 Deployment

7.2.1 General

Deployment details for each sign shall be documented in the “Deployment Work Order”. The work order shall specify deployment location, suggested type of installation, timeline for completion of the work and any applicable work constraints.

The scope of the PVMS deployment for each sign shall include:

a) Verification of the sign’s operational status and condition and required repairs prior to pick-up;
b) Pick up of the PVMS from the winter storage or roadside location;
c) Transport of the PVMS to the site designated in the Deployment Work Order;
d) Installation of the PVMS at the designated location;
e) Proof of performance and system integration testing to ensure readiness for operation;
f) Verification with the appropriate TOC, as indicated in the Deployment Work Order, that sign can be remotely controlled from that TOC.

The Owner will designate the deployment site and specify a ground trailer or fixed support deployment.

7.2.2 Ground Trailer Deployment

For ground trailer deployments the Portable Variable Message Signs shall be installed levelled and oriented towards approaching traffic at sites as designated by the Contract Administrator. The orientation of the sign face shall be such that the perpendicular axis of the sign face intersects the highway approximately 200 metres upstream of the sign. The Contractor shall survey the deployment area to verify if level ground exists for placement of the PVMS Trailer. The sign location may be adjusted to minimize implementation costs provided that it does not impact sign field of view and traffic advisory objectives.

For locations where a granular pad is not provided, the Contractor shall be responsible for levelling the sign using wood or concrete shims.

Should a wooden crib be required, it shall be provided in accordance with the Contract Drawings.

7.2.3 Fixed Support Deployment

For Deployment of the signboard and associated components on an existing fixed sign support structure, the display, battery and control unit compartments of the Portable Variable Message Sign shall be removed from the Portable Variable Message Sign trailer and mounted to the Variable Message Sign pole support.

The Contractor shall submit design calculations and shop drawings for the sign mounting to the Contract Administrator prior to installation on the pole structure or overhead truss. A Professional Engineer shall approve the structural calculations and drawings.

Battery and control unit compartments shall be resized where required to fit local conditions.

Exposed solar and battery power cables and control cables shall be protected by a watertight conduit and shall be provided and installed within and/or attached to the sign support pole.

Cable installation work shall be completed by a Licensed Electrician.

7.3 Timely Completion of the Deployment

The Contractor shall be required to complete the deployment of the PVMS within the time specified in the Deployment Work Order, typically one (1) week. In some isolated cases the installation of the PVMS may be required within two (2) days.

Should weather conditions or other circumstances prevent the Contractor from completing the work, the Contractor shall submit a written request for Extension of Time.

The request for Extension of Time shall be submitted within 48 hours of receipt of the Deployment Work Order by the Contractor. The extension of time request shall include the justification for extension and the proposed new deployment deadline. The Owner will review the request for Extension of Time and, if justified, provide written approval.

Failure to complete deployment work within the original deployment deadline or the approved extended deployment deadline shall result in monetary penalties. The Owner shall deduct the amount of $200 per PVMS for each calendar day of unapproved delay in the deployment deadline. The monies will be deducted from the next invoiced amounts due to the Contractor.

7.4 Winter Deployment

A limited number of winter deployments will be required. With winter deployments, the Contractor shall adhere to the same scope of work as for deployment within the construction season and include any extra work such as snow and ice removal and securing of cribs to frozen ground.

7.5 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of the Portable Variable Message Sign Deployment. The framework for the approval process shall be as specified elsewhere in the Contract Documents.

The following identifies the specific quality control requirements for this item:

System Integration Testing

Following installation of all Portable Variable Message Signs, the Contractor shall demonstrate error free integrated operation with the host computer at the applicable Traffic Operations Centre as defined in the Deployment Work Order.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of deployment is for each PVMS deployed.

The unit of measurement is each.

For the Ground Deployment of Portable Variable Message Signs Contract item, the Contractor shall provide an all-inclusive average cost for deployment in accordance with the requirements of this Special Provision and based on the following anticipated breakdown of deployment types:

a) Ground Trailer Deployment – **____________percent of item quantity;
b) Ground Trailer Deployment on wooden crib or requiring crane – ***____________percent of item quantity.

10. BASIS FOR PAYMENT

Payment at the Contract price for the above tender items shall be full compensation or all labour, equipment and Material required to do the work.

NOTES TO DESIGNER:

* Fill in the deployment area under the Contract.

** Fill in the percentage of ground trailer PVMS deployments under the Contract. Typically, this percentage is 90% of item quantity.

*** Fill in the percentage of ground trailer PVMS deployments under the Contract that require a wooden crib or a crane. Typically, this percentage is 10% of item quantity.

WARRANT: Always with these items, except for Capital Contracts.

MAINTENANCE AND WARRANTY FOR PORTABLE VARIABLE MESSAGE SIGNS – Item No.

____

Special Provision No. 681F34 September 2007

1. SCOPE

This Special Provision covers the requirements for Maintenance and Warranty of Portable Variable Message Signs (PVMS) and associated subsystem components. The scope includes:

a) Provision and maintenance of communications between each sign and the Traffic Operations Centre(s).

b) Routine Maintenance and Emergency Repairs to the Portable Variable Message Signs in accordance with terms and conditions of this Contract to maintain their uninterrupted operation.

c) Winter storage for the signs not deployed during winter.

The geographic scope of the Maintenance and Warranty is area that encompasses the following Regions or Counties: * ____.

2. REFERENCES – Not Used

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Critical Failure: means any failure causing communications loss or failure of PVMS components such that PVMS operations are degraded, as determined by the Owner.

Emergency Repairs: means any activity required to bring the PVMS to full functionality in accordance with the specifications other than Routine Maintenance activities.

Equipment: means all electrical or mechanical devices and vehicles used or reasonably required for use in Emergency Repairs or Routine Maintenance of the System Components.

Month: means the period of time, usually 30 or 31 days, from the date of initiation of Maintenance Phase to the recurrence of that date in successive calendar months.

Phase II of Contract: means items of work listed in the tender as Phase II items. The work for these items shall commence upon issue of completion of all Phase I items in their entirety and include Maintenance and Warranty for PVMS.

Routine Maintenance: means ongoing preventive maintenance activities in accordance with the manufacturer's recommendations and in accordance with this Special Provision and the System Components Maintenance and Service Manuals. Routine Maintenance includes the periodic adjustment of System components to correct deviations from System specifications resulting from normal operation of the System.

System Components: means all hardware and software components, devices, parts and materials included in the PVMS items supplied, installed, upgraded and/or replaced under Phase I including all spare parts supplied by the Contractor.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

Two weeks prior to anticipated acceptance of Phase I of the Contract, the Contractor shall submit a letter of intent indicating their readiness to proceed to Phase II of the Contract and the intention to submit the letter of credit. The letter of intent shall indicate the name of financial institution that will issue the letter of credit. At the Contractor's request, the Owner may provide a sample letter of credit.

The Contractor shall provide upon the date of acceptance of Phase I of the Contract an irrevocable letter of credit payable to the Minister of Finance in the amount of 100% of the Contract price for the Maintenance and Warranty for the Portable Variable Message Signs Contract item. This letter of credit shall constitute a guarantee of performance and shall be returned to the Contractor one month following the completion of Phase II except in the event of non-performance. In the event of non-performance the letter of credit shall be drawn upon by the Owner as required to pay for services which were not performed by the Contractor.

The letter of credit shall be issued by a Canadian Chartered Bank or Financial Institution, as approved by the Owner and shall have offices to administer such Letter of Credit within the **____________________ area.

The Letter of Credit shall be provided to the Owner within five (5) business days of achieving acceptance of Phase I.

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Duration

The duration of Phase II shall be 730 consecutive calendar days following the date of acceptance of Phase I.

The typical deployment schedule for the PVMS will be from April 1 to November 30. For the period from December 1 to March 31 the signs shall be removed from their deployment sites and transported to a winter storage facility, unless otherwise instructed by the Owner.

7.2 Operational Constraints (Traffic Control)

The Contractor shall follow all current operational constraints established by the Owner for traffic control when performing PVMS Routine Maintenance.

Should lane closures be required during Emergency Repairs, they shall be carried out with the approval and under the direction of the Superintendent of Electrical/ATM Services.

7.3 Warranty

The warranty shall cover any defects in materials and workmanship for all System Components. Any replacements required during Phase II shall be made and deemed to be included in the bid price for Maintenance and Warranty Contract items without additional charge for labour, equipment, materials and system components.

The Contractor shall be the warrantor of all System Components notwithstanding any supplier's warranties whether written or implied.

7.4 Maintenance

The Contractor shall maintain all System Components in good working condition in accordance with the Contract specifications and shall provide all Routine Maintenance and Emergency Repairs required to carry out this obligation.

Routine Maintenance shall comply with the manufacturer's recommendations and be in accordance with the manufacturer Operations and Maintenance Manual.

Prior to commencement of Phase II the Contractor shall identify in writing the procedures and schedule for Routine Maintenance and submit this procedure and schedule to the Owner's Representative for review and approval.

Prior to commencement of Phase II, the Contractor shall provide 24-hour/7 days a week on-call local emergency repair service phone number and contact person that shall be available during full duration of Phase II. Emergency Repairs shall be required whenever there is a failure or cessation of operation of any component of the PVMS covered by this Contract.

The Contractor shall ensure that the PVMS display faces the intended traffic stream at all times. Periodically, the PVMS display may rotate as a result of wind loading or other factors and will require realignment. These adjustments are considered to be part of routine maintenance.

During the Maintenance and Warranty period, the Contractor shall enter a detailed description of all work performed into the work logbook kept in the PVMS cabinet and the maintenance report form provided to the Contractor. As a minimum, those entries shall include the following:

a) Date and time;
b) PVMS serial number and current location, including GPS coordinates;
c) Log of the component or module failure;
d) Log of the serial number of failed module and replacement part, if applicable;
e) Log of the corrective action performed; and
f) Log of overall condition of the PVMS.

The Contractor shall complete the maintenance report form for all routine and emergency maintenance work and email it to the Owner's Representative the same day as the date of repair. The completed maintenance report form shall also be attached to the invoice for the work. The Owner will use the completed maintenance report form to verify the invoice for the work.

Only qualified Contractor personnel shall be allowed to perform maintenance activities on the PVMS. The Contractor shall have staff with minimum 3 years of experience in PVMS Maintenance or having PVMS vendor training certification completed within one year. Continuity of the staff shall be maintained as much as possible. The Contractor shall submit a list of the personnel and their qualifications who are trained and qualified to undertake the repairs, to the Owner, prior to the commencement of Phase II of the Contract.

Any staff turnovers shall be reported to the Owner and new names supplied. The Contractor shall be required to submit proof of qualifications and/or training of the new staff for Owner's review. The Owner may at any time request that the Contractor's staff demonstrate their skills. The Owner also reserves the right to terminate the Contract when staff are not able to demonstrate qualifications adequate for the intended execution of this Contract.

7.5 Storage

The Contractor shall provide secure storage for all PVMS not deployed in the field. The signs shall be inspected and cleaned upon removal from the field and prepared for storage such that they are ready for the next deployment. The preparation for the storage shall include inspection of the sign to identify any required repairs, lubrication of moving parts and treatment of rust.

Outdoor storage shall be permitted for all components except for batteries, modems and other sensitive components which should be stored indoors. Continuous trickle charging will be required to maintain battery life while the PVMS are in storage.

At the completion of the Contract, the Contractor shall deliver all PVMS to an Owner-specified location(s) within the area of ***____________________.

7.6 Communications

The Contractor shall provide continuous telephone data communications services to all PVMS in the field for the duration of the Maintenance and Warranty period. Each PVMS shall have a unique telephone number to support mobile digital communications with the host computer at the TOC.

The Contractor shall arrange for digital data connection (such as GPRS or 1X) for all PVMS in the fleet. The Contractor shall investigate various pricing options for data communications based upon an average communications requirement of 8 calls per day for each PVMS deployed to change messages or check operational status.

Any trouble shooting efforts required to restore/repair the communications with the PVMS are considered as "Emergency Repairs" and shall be part of the Maintenance and Warranty work. Such work shall be paid for in accordance with the payment guidelines for the item.

Within 30 days of the completion of the Maintenance and Warranty phase, the Contractor shall transfer ownership of the mobile telephone services to the Owner.

7.7 Response, Notification and Restoration

The Contractor shall clearly identify in writing the designated contact person and alternate for liaison with the Owner's Representative. The Owner's Representative will designate representatives and alternate contact persons for the TOC and the field equipment and provide this information to the Contractor.

The Contractor shall liaise with the Owner's maintenance personnel and shall notify the designated Owner's Representative or alternate prior to undertaking any Routine Maintenance or Emergency Repairs. The Owner's staff shall have the option to accompany the Contractor's staff when Routine Maintenance or Emergency Repairs are carried out. The Contractor shall record all entries into field cabinets in the logbooks provided by the Owner.

The Contractor shall respond to Emergency Repair calls by the Owner's Representative.

For Critical Failures, the time for the Contractor to respond on site shall not exceed two (2) hours. The Contractor shall restore full functionality within four (4) hours of responding on site.

For Non-Critical Failures the Contractor shall have 24 hours from the time of receipt of notification of a defect to restore the subsystems to a full functional condition meeting all requirements of the Special Provisions.

Critical Failures shall be restored to a full functional condition meeting all requirements of the specifications and to the satisfaction of the Owner's Representative within twelve (12) hours of notification of the failure.

7.8 Replacement of System Components

System Components required to perform Routine Maintenance and Emergency Repairs may, at the option of the Contractor, be obtained from the inventory of spare System Components supplied by the Contractor under Phase I of the Contract. However, where a component fails under ordinary operating conditions and insufficient or no spare components were provided under Phase I of the Contract, the Contractor shall supply the replacement components.

The Contractor shall, prior to acceptance of Phase II of the Contract, supply all components required to replenish the Owner's stock of spare components to the full requirements stated for Phase I without additional payment.

7.9 Annual Inspection and Status Reporting for PVMS

The Contractor shall provide, to the Owner, an annual inventory of PVMS conditions and states of repair. Inspections shall take place every December. The Contractor shall inspect all PVMS while all display elements are being exercised with an alternating test pattern (25% of the pixels on) in various brightness modes. The test pattern shall be run for a 5 minutes in order to inspect the following items:

a) All display elements and sub-systems shall be shown to be working properly within their specified ranges. The Contractor shall immediately replace any defective components.

b) All display elements shall be verified to exhibit consistent luminous output from pixel to pixel throughout the entire sign. The luminous consistency shall be verified in all brightness modes. The Contractor shall replace all display elements, which in the opinion of the Owner's Representative do not meet this requirement.

All display elements shall be verified to exhibit consistent colour from pixel to pixel throughout the entire sign. The colour consistency shall be verified in all brightness modes. The Contractor shall replace all display elements, which do not meet this requirement.

The Contractor shall produce a written report detailing the state of repair of all PVMS and submit it to the Owner on or before December 31 of each year, for the duration of the Contract.

Owner reserves the right to inspect the PVMS at Contractor's facility any time during business hours with 24 hour notice.

7.10 Scheduled Maintenance

The PVMS sign components shall be inspected as per the schedule and any time a sign is brought into storage from field deployment. The schedule and a checklist of items to inspect are listed below. Any non-functional parts shall be serviced immediately.

Minimum Maintenance Schedule

The minimum service schedule shall be performed for the duration of this Contract at the frequency indicated as follows:

Service	Frequency
Inspection	every three months
Clean sign face (inside and outside of sign face as required)	every three months
Test batteries and solar panels	As manufacturer recommended and weekly in winter
Test pixels for failure	As manufacturer recommended

Checklist

a) Inspect and test all the batteries and determine if they require replacement. Batteries, which are likely to last for not more than a month after the inspection, should be replaced.

b) Inspect and test all the solar panels and replace any defective solar panel. Clean the face of the solar panels using the approved cleaning agent as described below.

c) Visually inspect the sign (with a test pattern) to locate any non-functional pixels. Replace the non-functional pixels boards.

d) Inspect ventilation openings if applicable. Clear any clogs in output vents.

e) Use glass cleaner to clean photo sensor bubble. Clean sign face using manufacturer approved solution.

f) Inspect the weather stripping on the sign case; check paint condition for peeling.

g) Inspect the sign face for chips and cracks.

h) Visually check the sign trailer and crib if applicable or PVMS support structure.

Sign Face Cleaning

The sign face must be cleaned when it becomes dusty and dirty, thereby obscuring the sign display, or at least at the scheduled maintenance using manufacturer's approved products.

Use of any cleaning agents that contain chemicals harmful to either persons or the sign face shall be avoided. The Contractor shall exercise all safety precautions required in handling any chemicals and/or cleaning agents; all personnel shall be trained in their proper handling and disposal. All employees shall be trained in First Aid.

The sign face shall not be cleaned when it is exposed to direct sunlight. The Contractor shall choose a time when the face of the sign is in shade or when the sky is overcast.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the Maintenance and Warranty is for each PVMS maintained over a one (1) year period.

10. BASIS FOR PAYMENT

Basis for Payment at the Contract Price for the above tender item shall be as follows:

a) Maintenance and Warranty to include all scheduled maintenance and emergency repair work required to maintain uninterrupted operation of the PVMS within duration of Phase II and including storage. The Contractor shall provide an all-inclusive cost for maintenance of each PVMS for the period of one year of the duration of Phase II of the Contract including all costs associated with routine maintenance and adjustments, communications, winter maintenance and storage.

b) Average Contract price for each PVMS maintained shall reflect the additional cost of all scheduled maintenance and emergency repair work required to maintain uninterrupted operation of one PVMS during a winter season.

c) It is understood that the PVMS Maintenance and Warranty is more demanding during winter months. For the purpose of the bid the Contractor shall assume that ****________________ PVMS signs will be deployed each winter.

d) Except in case of damage caused by others, the Contractor shall provide all labour, equipment, and materials required to carry out the maintenance and emergency repairs at his expense.

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment, Materials and services required to provide Maintenance and Warranty for each PVMS. The following payment guidelines shall apply:

a) Payment will be made monthly and will be calculated by dividing the unit Contract price for "Maintenance and Warranty" and "Extended Maintenance and Warranty" by 12 for each PVMS maintained during the month.

b) Payment for the Extra Work will be made based on the actual work approved and completed within the pay period and on monthly basis.

c) Final payment for this Contract item and the return of the Letter of Credit shall occur at the end of Phase II plus one month. The holdback of payments for Phases II will cover these tender items only and will not apply to Phase I work.

10.1 Default and Notice of Non-Compliance

Each time the Contractor fails to respond to a request for Emergency Repair within the time limits specified in this Special Provision, the Owner shall record the amount of time which elapses between the end of the specified response time and the time of actual response.

The Contractor shall be sent notice of non-performance in any event that:

a) The total number of hours of delay in any given seven-day period exceeds 8 hours for response and restoration;

b) The PVMS is not available for use or not operating according to the Contract Specifications for a period of one month or more; or

c) The total number of hours of delay exceeds 48 hours per month for 3 consecutive months; or

d) The response times are exceeded twice for non-critical failures within any seven-day period; or

e) The response times are exceeded once for critical failures within any seven-day period; or

f) The restoration time is exceeded twice within any seven-day period.

The Contractor shall also be in default if he fails to provide Routine Maintenance in accordance with the Contractual procedures and schedules.

In the event the Contractor does not remedy the non-performance within 30 days of notification of non-performance, the Owner will deal with the Contractor by drawing upon the Letter of Credit as required to recover the additional costs it incurs as a result of the Contractor's default.

NOTES TO DESIGNER:

* Fill in the deployment area under the Contract.

** Identify area within which financial institution should be located.

*** Identify storage geographic area.

**** Specify number of signs that will need to be maintained in winter months each year.

WARRANT: Always with this item.

ATMS FIELD EQUIPMENT CABINET MAINTENANCE SITES - Item No.

Special Provision No. 682S01 September 2007

1. SCOPE

This Special Provision covers the requirements for the construction of ATMS Field Equipment Cabinet Maintenance Sites and includes all work required at each site, as shown in the Contract Drawings (i.e. typical cross-sections at each site).

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 180 Management and Disposal of Excess Material
OPSS 206 Grading
OPSS 212 Borrow
OPSS 314 Untreated Granular, Subbase, Base, Surface, Shoulder and Stockpiling

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS – Not Used

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

The ATMS field equipment cabinet maintenance sites shall be constructed in accordance with the Contract Drawings.

Earth excavation, stripping and earth fill shall be obtained and placed in accordance with the requirements of OPSS 206.

Earth borrow shall be obtained and placed in accordance with the requirements of OPSS 212.

Unsuitable surplus excavated material shall be managed in accordance with the requirements of OPSS 180.

Granular pads shall be constructed using Granular "A" material in accordance with the requirements of OPSS 314.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of ATMS Field Equipment Cabinet Maintenance Sites is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials to do the work.

WARRANT: Always with this item.

FLEXIBLE DUCTS BY SUBSURFACE INSTALLATION – Item No.
RIGID DUCTS, DIRECT BURIED - Item No.
RIGID DUCTS, DIRECT BURIED (TEMPORARY) – Item No.

Special Provision No. 682S07 February 2009

Amendment to OPSS 603, Novemeber 2008

603.05 MATERIAL

603.05.08 Ducts and Fittings

Subsection 603.05.08 of OPSS 603 is amended by the addition of the following:

Select rigid ducts direct buried for ATMS shall be colour coded. The ducts designated in the drawings as “C” shall be orange. The ducts designated in the drawings as “P” shall be red. All other ducts shall be grey.

603.07 CONSTRUCTION

603.07.06 Flexible Ducts

Subsection 603.07.01 of OPSS 603 is amended by the addition of the following:

Runs of HDPE ducts by subsurface installation shall be done with a single run of unspliced duct between electrical chambers.

603.07.05.02 Earth Excavation

Clause 603.07.01.07 of OPSS 603 is amended by the addition of the following after the first paragraph:

Communications ducts shall be installed in inclined trenches to provide drainage of water out of ducts. The minimum cover depth of 450 mm may be used in ‘flat’ terrain or as otherwise required, in order to ensure that the ducts slope towards the electrical chamber. Where the terrain will allow natural drainage due to its slope, a standard cover depth of 550 mm shall be used.

WARRANT: All ATMS Contracts with these items.

SURFACE MOUNTED DUCT SYSTEMS - Item No.
SURFACE MOUNTED DUCT SYSTEMS (TEMPORARY) - Item No.

Special Provision No. 682S08 February 2009

Amendment to OPSS 603, November 2008

603.05 MATERIALS

603.05.08 Ducts and Fittings

Subsection 603.05.08 of OPSS 603 is amended by the deletion of the last two paragraphs and addition of the following:

For surface mounted ducts where runs of multiple ducts exceed 5.0 m in length in continuous runs, rigid ducts and fittings shall be of regular wall thickness, watertight RE duct, conforming to CAN/CSA C22.2 No. 211.3-96.

Hanger support systems shall consist of plated steel bar with tubular supports and spacers with stainless steel hardware as indicated in the Contract. The support systems shall allow for multiple sizes of duct in each horizontal layer.

For surface mounted ducts for local runs less than 5.0 m in total length, vertical runs and minor connecting ducts, ducts shall be rigid PVC conduit, non-metallic liquid tight flexible conduit and connectors, RE duct or rigid stainless steel conduit as indicated in the Contract.

603.05.10 Concrete Anchors

Subsection 603.05.10 of OPSS 603 is deleted and replaced with the following:

603.05.10 Adhesive Anchors

Adhesive anchors shall consist of two-part chemical systems using epoxy, urethane or other suitable resins having a minimum bolt pull-out strength of 55 kN when used with 125 mm deep holes for side mounting (L-bracket) and 170 mm deep holes for suspended installations and hole diameters as recommended by the manufacturer.

603.07 CONSTRUCTION

603.07.10 Surface Mounted Duct Systems

Subsection 603.07.06 of OPSS 603 is amended by the addition of the following:

Drilling through the bridge reinforcing steel shall not be permitted. The Contactor shall locate reinforcing steel with a covermeter and position anchors accordingly.

‘O’ ring expansion joints shall be installed in the ducts at each structural expansion joint and at other locations as indicated in the Contract. The insertion of ducts into the expansion joints shall be carried out with particular attention given to obtaining the proper insertion depth in accordance with the manufacturer's instructions.

At the midspan hanger support locations, the threaded rods shall be stabilized against movement by the installation of a stainless steel brace installed in accordance with the manufacturer's instructions.

Final tightening of all nuts shall be done with the application of thread sealant.

WARRANT: All ATMS Contracts with these items.

EXTRA LOW VOLTAGE CABLES, IN DUCTS - Item No.
EXTRA LOW VOLTAGE CABLES, IN DUCTS (TEMPORARY) – Item No.
EXTRA LOW VOLTAGE CABLES IN SAWCUT SLOTS - Item No.
SAWCUT SLOT FOR EXTRA LOW VOLTAGE CABLES - Item No.

Special Provision No. 682S09 February 2009

Amendment to OPSS 604, November 2008

604.02 REFERENCES

Section 604.02 of OPSS 604 is amended by the addition of the following:

Ontario Provincial Standard Specifications, Construction:

OPSS 623 Traffic Actuation Equipment

604.07 CONSTRUCTION

604.07.10 Cables in Ducts

Subsection 604.07.02 of OPSS 604 is amended by the addition of the following:

Extra low voltage cables in ducts shall be installed in continuous runs from the loop detector splice point to the controller cabinet. Intermediate splices shall not be permitted unless otherwise indicated unless otherwise indicated in the Contract Drawings.

The installation of split duct protection around low voltage and extra low voltage cables installed in electrical chambers shall be carried out in accordance with the Contract Drawings.

Section 604.07 of OPSS 604, is amended by the addition of the following subsection:

604.07.19 Cables in Sawcut Slots

Extra low voltage cables in saw-cut slots shall be installed in continuous runs from the loop detector splice point to the controller cabinet. Intermediate splices shall not be permitted unless otherwise indicated in the Contract Drawings. Sawcuts shall be filled with sealing compound in accordance with OPSS 623.

604.09 MEASUREMENT FOR PAYMENT

Subsection 604.09.01 of OPSS 604 is amended by the addition of following clause:

604.09.01.03 Extra Low Voltage Cables in Sawcut Slot
Sawcut Slot for Extra Low Voltage Cables

Measurement for 'Extra Low Voltage Cables in Sawcut Slot' and 'Sawcut Slot for Extra Low Voltage Cables' shall be by Plan Quantity as may be revised by Adjusted Plan Quantity of the horizontal length in metres along the centre of the sawcut slot and along the centre of the connecting ducts, from centre to centre of electrical chambers.

604.10 BASIS OF PAYMENT

Section 604.10 of OPSS 604 is amended by the addition of the following subsections:

604.10.04 Sawcut Slot for Extra Low Voltage Cables - Item

Payment at the Contract price for the above tender item shall include full compensation for all labour, Equipment and Material required to do the work including sawcutting, sealing of slots, installation of flexible ducts and installation of split duct protection in electrical chambers.

604.10.05 Extra Low Voltage Cables in Sawcut Slots - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work, but excludes the sawcutting, sealing of slots and the installation of flexible ducts. Compensation for these items of work shall be made under the Contract item "Sawcut Slot for Extra Low Voltage Cables".

WARRANT: All ATMS Contracts with these items.

<u>POWER SUPPLY CABINETS</u> - Item No.

Special Provision No. 682S12 February 2009

1. SCOPE

This Special Provision covers the requirements for the installation of Power Supply Cabinets.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 603	Underground Ducts
OPSS 604	Cable Installation
OPSS 609	Grounding

Canadian Standards Association:

CSA Standard C22.2 No. 211.2-06	Rigid PVC (Unplasticized) Conduit
CSA Standard C22.2 No. 29-M1989	Panelboards and Enclosed Panelboards
CSA Standard C22.2 No. 94-M91	Special Purpose Enclosures; Industrial Products
CSA Standard C22.2 No. 5-02	Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures
CSA Standard C22.2 No. 47-M90	Air Cooled Transformers (Dry Type)

American Society for Testing and Materials (ASTM):

ASTM A-666-03	Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
ASTM A480/A480M-06b	Standard Specification for General Requirements for Flat-Rolled Stainless and Heat-Resisting Steel Plate, Sheet and strip

National Electrical Manufacturers Association (NEMA):

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) – NEMA 4X Type

Others:

Ontario Electrical Safety Code

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit the shop drawings and specification sheets for the power supply cabinet internal components to the Contract Administrator prior to ordering. Manufacturer part numbers and description of all equipment being supplied shall be included.

5. MATERIALS

5.1 Power Supply Cabinet

Power supply cabinet - shall be NEMA 4X, stainless steel Type 304 - 2B, 14-gauge, in accordance with applicable ASTM standards. 1220mm Height x 915mm Width x 405mm Depth, service type with hasp to accommodate an Owner provided padlock.

Pedestal shall be formed type 304 – 2B, 12 Gauge, stainless steel to suit the power supply cabinet.

Power supply cabinet shall include moisture absorbing dessicant and vapour corrosion inhibitor.

Power supply cabinet shall include lightning arrestor rated for the size of the service.

Transformers shall be EP dry type, 600 – 240/120V manufactured in accordance with CSA standard C22.2 No. 47 -M90 and CSA Standard C22.2 No 94-M91 Special purpose enclosures.

Primary breakers shall be integral fused breaker, Tri-Pac or equivalent, combination interrupting rating of 200KA, 600V. The wire size form the splitter to the primary breaker shall comply with the ESA standards. Ampere rating of the breakers shall be as follows:

a) for 5 kVA, 15A;
b) for 10 kVA, 20A;
c) for 15 KVA, 30A;
d). for 25KVA, 50A.

Secondary breakers 120/240 V, shall be molded case circuit breakers complying with the standards as shown above, enclosed, with AC Interrupting Rating rms Symmetric Amperes not less than 10KA, ampere rating from 15A to 100A.

Distribution panelboard shall be in accordance with CSA C22.2 No. 29-M1989 and CSA C22.2 No. 94-M91. Loadcenters designed for residential or light commercial usage are not acceptable. The main lug or main breaker shall be 225A. SCCR or AC interrupting Capacity rms Symmetrical Amperes shall be 10-22KA fully rated. It shall allow not less than 12 branch circuits. The Branch breakers shall be molded case circuit breakers in accordance with CSA C22.2 No. 5, with AC Interrupting Rating rms Symmetric Amperes not less than 10KA, ampere rating from 15A to 100A, physically fit inside the panelboard.

5.2 Cables and Cable Connectors

Low voltage cables and ground wire between the power supply cabinet and the controller cabinet shall be #6 AWG, RWU90 and shall meet the requirements of OPSS 604 and OPSS 609.

Cables and cable connectors shall meet the requirements of OPSS 604.

5.3 Grounding Materials

Grounding materials shall meet the requirements of OPSS 609.

5.4 Conduit and Fittings

Rigid PVC conduit and fittings for the installation of pole-mounted equipment shall meet the requirements of CSA Standard C 22.2 No. 211.2.

Non-metallic liquid-tight flexible conduits and connectors shall meet the requirements of OPSS 603.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Assembly of Power Supply Cabinets

The Contractor shall assemble all components within the cabinets using applicable code clearance rules.

7.2 Padlocks

The Contractor shall install padlocks supplied by the Owner.

7.3 Cables and Fuses

Cables, terminations and connections shall be installed in accordance with the requirements of OPSS 604. Service cables, from the point of service connection to the main disconnection device shall meet the requirements of Ontario Electrical Safety Code.

Wiring within the cabinets shall be installed in liquidtight flexible conduits.

7.4 Grounding

All pad mounted equipment shall be grounded by means of ground wire jumpers connected between the equipment ground bus and the exterior ground grid. Lighting arrestors shall have the ground cable connected securely to the equipment ground bus. The neutral bus of the main disconnection device or the secondary neutral terminal of the transformer shall be grounded.

The system ground wire and the service ground wire shall be connected to the neutral bus.

All grounding work shall be carried out in accordance with the requirements of OPSS 609.

7.5 Quality Control

Pre-installation Testing and Inspection

The Contractor shall inspect the power supply equipment to ensure that it meets the requirements of the Contract. In particular, and without limiting the foregoing, the Contractor shall perform a visual inspection of all the power supply equipment prior to its delivery. The Contractor shall as a minimum inspect the following components as many as applicable to ensure that they meet the requirements of the Contract:

General Appearance	Grounding Connections	Panel boards
Insulation	Grounding and Bonding Materials	Contactors
Transformers	Enclosures Materials	Thermostats

Wires and Connectors	Cabinet Materials	Exhaust Fans
Labelling	Doors and Latching Mechanisms	Barriers/Raceways
Switches	Conduits and Tubing	Circuit Breakers
Any other components		

Proof of Performance Testing and Inspection

The Contractor shall perform visual inspection on the installed power supply equipment, inspecting all components, as listed under Pre-installation Testing and Inspection. In addition, the Contractor shall perform Low Voltage System tests on wiring of the equipment in conformance to OPSS 604. The Contractor shall perform all tests on grounding of equipment in conformance with OPSS 609.

The inspection, testing, and test results shall be witnessed by the Quality Verification Engineer. The Quality Verification Engineer shall issue a Certificate of Conformance that the work has been inspected and tested, and that the material and installation are in General Conformance with the requirements of the Contract.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of Power Supply Cabinets is by Plan Quantity as may be revised by Adjusted Plan Quantity. The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work. Payment shall include all costs of installation of all cabinets, cabinet components, wiring, internal conduits, grounding, and pedestals.

WARRANT: All Contracts with this item.

CONCRETE POLES, DIRECT BURIED IN EARTH - Item No.

Special Provision No. 682S13 February 2009

Amendment to OPSS 615, November 2008

615.05 MATERIALS

Section 615.05 of OPSS 615 is amended by the addition of the following subsection:

615.05.06 Concrete Pole Fill

Concrete pole fill shall have a minimum compressive strength of 3.5 MPa.

615.07 CONSTRUCTION

Subsection 615.07.03 of OPSS 615 is amended by the addition of the following clauses:

615.07.03.04 Pole Filling

The hollow core of the pole shall be filled with concrete up to the lower wiring aperture level. Duct opening shall be covered with metal plate after duct installation.

615.07.03.05 Duct Entry

The Contractor shall trim the pole wiring aperture to allow duct entry and mortar the duct in place.

WARRANT: All ATMS Contracts with this item.

<u>CONCRETE PADS</u> - Item No.

Special Provision No. 682S14 February 2009

Amendment to OPSS 616, November 2008

616.05 MATERIALS

Section 616.05 of OPSS 616 is amended by the addition of the following subsections:

616.05.12 Pea Gravel

Pea gravel shall be clean, washed, smooth stone to the following gradation:

Passing 13.2 mm sieve - 100%
Passing 2.35 mm Sieve - 0%

616.05.13 Concrete Backfill

Concrete Backfill shall have a compressive strength of 3.5 MPa.

616.07 CONSTRUCTION

Section 616.07 of OPSS 616 is amended by the addition of the following subsections:

616.07.10 Construction on Slopes

Where concrete pads are installed on slopes, the Contractor shall install concrete footings at the front and sides of the pads as indicated in the Contract Drawings.

616.07.11 Miscellaneous Features

The Contractor shall install clean pea gravel, 300 µm plastic sheeting and concrete backfill as indicated in the Contract Drawings.

616.07.12 Rigid Ducts

This work includes the installation of internal rigid PVC ducts, associated with pads, in accordance with the requirements of OPSS 603. All ducts shall be permanently marked in accordance with the identification terminology used in the construction detail drawing. The marking shall be performed using indelible ink directly on the ducts or in a manner approved by the Contract Administrator. The marking shall be visible from the front or rear doors of the cabinets to be mounted on the pads.

WARRANT: All ATMS Contracts with this item.

1. SCOPE

This Special Provision covers the requirements for the installation of base mounted communications pedestal on a concrete footing as shown in Contract Drawings.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the Base Mounted Communication Pedestals to the Contract Administrator prior to ordering and manufacturing.

5. MATERIALS

Communications pedestals shall be constructed of 12 gauge galvanized steel with vinyl prime coat and alkyd enamel baked-on finish; colour shall be grey. Pedestals shall be supplied with dual doors on each side complete with a recessed 1/8 turn catch and stainless steel padlock hasps and hardware. Pedestal size shall be 767 mm width x 366 mm depth x 958 mm height.

Ventilating louvers backed with aluminium insect screening shall be provided in the front and rear doors. The interior of the pedestal shall be provided with two cross-slotted equipment mounting plates.

Pedestals shall be supplied with all mounting hardware and components required for secure installation on a concrete footing.

5.1 Terminating Block

5.1.1 Terminating blocks shall be provided in the pedestal to terminate twisted pair cables.

5.1.2 Terminating blocks shall be capable of accepting a minimum of two pair of conductors.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

Threaded inserts shall be installed on the pedestal footing to enable installation of the pedestal, as recommended by the manufacturer. The position shall match the pedestal mounting requirements.

Pedestals shall be installed plumb and level on a concrete footing as shown in the Contract Drawings.

Pedestals shall be identified with a laminated phenolic plastic nameplate similar to that required for cabinets as detailed elsewhere in the Contract. The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates. Identification plates shall be mounted with stainless steel screws at 100 mm from the top of the pedestal, facing the roadway.

The Contractor shall install Owner supplied padlocks.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of base mounted communication pedestals installed is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work.

WARRANT: Always with this item.

<u>CONTROLLER CABINETS</u> - Item No.

Special Provision No. 682S16 September 2007

Amendment to OPSS 622, September 1993

622.05 MATERIALS

Section 622.05 of OPSS 622 is amended by the addition of the following subsections:

622.05.09 Components

Cabinets shall meet the requirements of the current version of the Ontario Traffic Signal Control Equipment Specifications (OTSCES) and all applicable addenda, except as noted below.

The requirements of the OTSCES are revised as follows:

Section 3.2.1 of Chapter 13, Specifications for the digital thermostat panels is amended with the following:

Function	Description	Preset Value
Ht	Heater turn on temperature	+10.0
Ht.HS	Heater Hysteresis value	+5.5
Fn	Fan turn on temperature	+25.0
Fn.HS	Fan hysteresis value	+5.5
HI.Ct	High cut-off temperature of critical equipment	+55.0
HI.HS	High cut-off hysteresis	+2.0
LO.Ct	Low cut-off temperature of critical equipment	-10.0
LO.HS	Low cut-off hysteresis	+2.0
HI.FL	High cut-off count; the number of times the temperature has exceeded HI.Ct to a maximum of 999	0
LO.FL	Low cut-off count; the number of times the temperature has exceeded LO.Ct to a maximum of 999	0
HI.t	Highest temperature since last reset	+99.99
LO.t	Lowest temperature since last reset	-99.99

622.05.10 Service Light

Lamps shall be 50W energy efficient rated for rough service.

The lamp shall be installed after the cabinet is mounted in the field.

622.07 CONSTRUCTION

622.07.03 Timing of Work

Subsection 622.07.03 of OPSS 622 is amended by the addition of the following:

The controller cabinet shall be energized immediately following installation and all environmental equipment shall be operational.

622.07.04.05 Equipment Ground

Clause 622.07.04.05 of OPSS 622 is deleted and replaced with the following:

The controller cabinet ground shall be connected to the system ground at the power supply cabinet ground bus in accordance with the requirements of OPSS 609 or, the neutral cable shall be connected to the cabinet AC - terminal and kept independent of the grounding facilities.

622.07.05.04 Identification of Equipment

Clause 622.07.05.04 of OPSS 622 is deleted and replaced with the following:

622.07.05.04 Cabinet Identification

The Contractor shall install a laminated phenolic plastic nameplate on each installed cabinet. The nameplate shall be installed on the side of the cabinet facing the highway or so as to be easily seen when approaching along the highway. Nameplates shall be 450 mm x 70 mm with 50 mm high white lettering, 8 mm letter stroke width and 6 mm spacing between letters, on a black background (Example: 401CE0420DEC). Letters shall be generated by an engraving machine. In cases where cabinets are installed behind noise walls, the nameplate shall be installed over or on the front door of the cabinet and an additional nameplate shall be installed on the highway side of the noise wall, over the access door. Nameplates shall be fastened with four stainless steel self tapping screws, with 'Robertson' No. 2 (red) heads. The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates.

The name plate shall contain the full 12 characters of the Universal Identifier including the highway name.

622.07.06 Quality Control

Subsection 622.07.06 of OPSS 622 is deleted and replaced with the following:

The framework of the approval process shall be as specified elsewhere in the Contract Documents.

622.07.06.01 Pre-Installation Testing

The Contractor is required to perform quality control testing on 10% of cabinets and 100% of digital thermostats prior to delivering the cabinets and thermostats. The Contractor shall test each cabinet and thermostat to confirm that it meets the requirements of the Ontario Traffic Signal Control Equipment Specifications (OTSCES).

The quality control testing and test procedures shall include, but not be limited to the following:

Visual Inspection

The Contractor shall perform detailed visual inspection to confirm that the following aspects of the cabinet are in compliance with the requirements of the Ontario Traffic Signal Control Equipment Specifications (OTSCES) as applicable for the appropriate cabinet type:

General Appearance
Cabinet Dimensions
Finish
Locks
Door Handles
Door Frames
Latching Mechanism
Door Hinges, Pin and Bolts
Catches
Louvred Vents and Filters
Gaskets
Heater Bracket
Storage for Drawings
Front Face Plate
Fan Ventilation Area
Cabinet Pedestal
Output Files
Equipment Racks
Lifting Eyes
Trouble Lamp
Insulation
Ventilation Requirements
Heating Requirements
Side Panel
Input Panel
Service Panel
Labelling
Cabinet Wiring Diagram
Power Distribution Assembly
Conductors
Colour Coding
Terminal Blocks
24 Volt DC Power Supply
Power Supply Front Panel
Input Files
Digital Thermostat
Connectors and Harness
Screws

Functional Testing

The Contractor shall measure the following cabinet attributes:

Paint Thickness

The Contractor shall perform functional tests of the following components:

Trouble Lamp
Input Files Wiring
24 Volt DC Power Supply
Power Distribution Assembly
Fan
Heater
Main Power Disconnect
Digital Thermostat
Output Files Wiring

622.07.06.02 Proof of Performance Testing

The Contractor shall energize each cabinet and confirm proper operation of 24 VDC power supply, heaters, fans, thermostats and service lights.

622.07.06.03 System Integration Testing

The Contractor shall carry out System Integration Testing to ensure that the cabinets perform to the specified standards when operated as follows:

a) in operation with controller units, detector sensor units and actuation devices installed under the Contract.
b) in operation with existing control and actuation devices.

622.09 MEASUREMENT FOR PAYMENT

Section 622.09 of OPSS 622 is amended by the addition of the following:

Measurement of the number of controller cabinets installed is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

622.10 BASIS OF PAYMENT

Clause 622.10.02 of OPSS 622 is amended by the addition of the following:

622.10. 02.03 Controller Cabinets - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work, except System Integration Testing which is paid for under a separate item.

WARRANT: Always with this item.

<u>CONTROLLERS</u> - Item No.

Special Provision No. 682S17 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of advanced traffic controllers (ATCs).

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange

Institute of Electrical and Electronics Engineers:

IEEE 802.3 IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

International Organisation for Standardization (ISO):

ISO 9000 Quality Management Systems

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

ATC: means advanced traffic controller. This term is used interchangeably with "controller". The ATC is an expandable, flexible, microprocessor-based traffic controller, designed to run the Owner's application software, which has been developed for the Intel x86 family of microprocessors, running QNX 6.3 real-time operating system.

CMOS: means complementary metal oxide semiconductor.

CSA: means Canadian Standards Association.

FLASH RAM: means constantly powered non-volatile memory.

IP: means Internet protocol.

QNX: means a real-time operating system by QNX Software Systems.

PC/104: means a common local bus used in industrial computers.

PCI: means peripheral component interconnect, which is a common local bus used in personal computers.

RAM: means random access memory.

STD: means a common local bus used in industrial computers.

TCP: means transmission control protocol.

USB: means universal serial bus, which is a common external serial bus used for connecting peripheral devices.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the ATC units to the Contract Administrator for review prior to ordering.

Each autonomous item shall be supplied with sufficient documentation to include the following information as a minimum:

a) General description of item
b) Installation
c) Adjustments
d) Theory of operation
e) Programming details (if applicable)
f) Memory and I/O maps (if applicable)
g) Schematic and logic assembly drawings
h) Maintenance and trouble shooting guide

5. MATERIALS

5.1 General Requirements

This section outlines general requirements of the ATC hardware applicable to all subsequent sections of the Special Provision.

5.1.1 Electrical Components

5.1.1.1 All equipment furnished under these specifications shall be of the solid-state design. Use of vacuum or gaseous tubes or electro-mechanical devices within the equipment shall be prohibited unless otherwise indicated.

5.1.1.2 All electrical components shall be industrial grade or better and shall be capable of withstanding the extreme environmental conditions specified within this document without degrading their design life.

5.1.1.3 Integrated circuits shall utilize CMOS technology to the greatest extent possible.

5.1.1.4 Semiconductor devices used shall be the best quality and grade available for the application. The integrated circuit manufacturers fan out rating shall not be exceeded.

5.1.1.5 All metal oxide semiconductor components shall contain circuitry to protect their inputs and outputs against damage due to high static voltages or electric fields and transient voltage surges.

5.1.2 Backplane Bus

5.1.2.1 The ATC hardware shall comprise of one of the following: PC/104, PC/104-Plus or PCI. Other industry standard backplane buses architectures will be considered, subject to the Ministry's approval.

5.1.2.2 All backplanes shall comprise vertically mounted bus connectors. The backplane shall be keyed to prevent improper board orientation insertion.

5.1.2.3 All modules, whether mounted vertically or horizontally, shall meet or exceed all environmental, electrical and mechanical requirements of this Special Provision. Special consideration shall be given to horizontally mounted boards to guard against condensation and heat transfer problems.

5.1.2.4 A special I/O backplane shall be permitted to interface I/O modules to the main subsystem backplane. Otherwise, only one system bus shall be permitted.

5.1.2.5 All plug-in modules supplied shall be manufactured to meet or exceed the specifications of the backplane bus supplied.

5.1.2.6 The backplane shall provide a minimum of two spare slots when the ATC is fully equipped as defined by this hardware Special Provision.

5.1.3 Connectors

5.1.3.1 All connectors shall be keyed to prevent improper insertion and, if applicable, have screw down mechanical fastening capabilities.

5.1.3.2 All RS-232 connectors shall be of the DB9 sub-connector type. Each RS-232 connector shall be of the male gender and shall be configured as a DTE device.

5.1.3.3 All PCB edge connectors shall meet or exceed the requirements of the bus standard employed.

5.1.3.4 Ribbon connectors shall terminate with properly rated and easily repairable insulation displacement connectors. If available, ejector latches should be provided at all connection points to facilitate the removal of connectors.

5.1.3.5 The digital outputs and inputs shall be terminated in a 104 pin (female) contact socket block connector, AMP 205720-2 or equivalent. The connector shall be designated as C1. The C1 connector shall provide 44 input, 16 output, and 4 ground circuits as illustrated in Attachment 1. The C1 connector shall have two corrosion resistant corner guide pins located near contact pins 1 and 104, and two corrosion resistant corner guide sockets near pins 14 and 92.

5.1.3.6 The closed circuit camera high voltage outputs and analog inputs shall be terminated in a 14 pin (female) contact socket block connector AMP 206043-1 or equivalent and a terminal block. The connector shall be designated as C2. The C2 connector and terminal block shall provide all outputs and inputs as illustrated in Attachment 2.

5.1.3.7 All terminal blocks attached to the exterior of the custom chassis shall be the barrier type accepting fork type connectors and shall be provided with 8-32 x 5/16 inch nickel plated brass binder head screws and inserts. Terminal blocks shall be rated for 15A, 600 V RMS minimum.

5.1.3.8 All C1, C2 and terminal block connectors shall be fully wired even if there is no I/O terminal assigned. Any unassigned connector wires shall be a minimum of 300 mm in length, and are to be tied and bundled within the custom enclosure.

5.1.3.9 The VGA video connector shall be of the female DB15 sub-connector type.

5.1.3.10 All USB connectors shall be USB type "A" female.

5.2 Electrical Isolation

5.2.1 The use of insulating paper for the purpose of electrical isolation shall not be permitted unless otherwise specified. Where needed, electrical isolation shall be accomplished using stand offs or similar devices.

5.3 Mechanical Requirements

5.3.1 All assemblies shall be easily replaceable and accessible. All assemblies shall incorporate plug-in capability for their associated devices or PCBs.

5.3.2 All plug-in PCB slots shall be provided with 2 non-metallic guides securely attached to the assembly chassis.

5.3.3 The manufacturers name or logo, model number, serial number and circuit issue or revision number shall appear on all assemblies.

5.3.4 All screw type fasteners shall utilize locking devices or locking compounds except for finger screws which shall be captive.

5.4 Engineering Requirements

5.4.1 To the highest degree practicable, the ATC components shall be engineered for simplicity and ease of operation and maintenance.

5.4.2 All fuses shall be easily accessible and labelled and should be replaceable without the use of any tools.

5.4.3 All plug-in modules shall slide smoothly in their guides while being inserted into or removed from the ATC’s internal card cage sub rack. All PCBs shall fit snugly into the plug-in card cage sub rack PCB connectors and utilize a mechanical locking mechanism to prevent accidental loosening due to vibration.

5.4.4 The design of the ATC shall protect personnel from all dangerous voltages. All 120 VAC power distribution terminals shall be properly protected and signed for high voltage.

5.4.5 Sufficient space shall be made available within the ATC unit for the routing of cables between various modules and external connectors.

5.4.6 All PCB boards including I/O interface boards shall be coated with a moisture resistant coating. All sockets, connectors, jumpers, dipswitches and edge connectors shall be excluded and properly masked prior to coating application.

5.4.7 Although CSA and Ontario Electrical Safety Authority certification and inspection is not a requirement, wiring and manufacturing shall be compliant. All internal wire colours shall comply with standard wire colour codes.

5.5 Electrical Requirements

5.5.1 All electrical components within the ATC assembly shall operate properly with an applied AC line voltage of 115 +/- 10 VAC. All electrical components within the ATC assembly shall operate properly with an applied AC line frequency of 60 +/- 3 Hertz.

5.5.2 All components, when housed in the ATC chassis, shall be unaffected by transient voltages normally experienced on commercial power lines.

5.5.3 All components, when housed in the ATC chassis, shall be capable of normal operation following opening and closing of contacts in series with the applied voltage to the ATC chassis at a rate of 30 openings and closings per minute for a period of 2 minutes.

5.5.4 All electrical modules within the ATC assembly shall fully comply with local governmental requirements concerning the suppression of unintended radio frequency emissions.

5.5.5 All circuits shall be sufficiently protected against stray static electricity so as not to be damaged during normal shipping, handling and operation.

5.6 Environmental Requirements

5.6.1 All components and assemblies shall be manufacture certified to properly operate within an ambient temperature ranging from -30^{o}C to $+65^{o}$C. All components shall have a storage rating of -30^{o}C to $+65^{o}$C.

5.6.2 All components and assemblies shall properly operate with a humidity level ranging from 10 to 90 percent, non-condensing.

5.6.3 All assemblies shall be shock tested to 25 G.

5.6.4 All assemblies, excluding the chassis, shall be vibration tested from 20 to 2000 Hz.

5.7 Central Processing Unit Assembly

5.7.1 The CPU Assembly (CPUA) shall comprise the components listed below on no more than 2 plug-in PCB modules occupying no more than 2 backplane slots. Although it is not a requirement, the CPU assembly is preferred to be a single board.

5.7.2 The CPUA shall include one of the following microprocessor units:

a) 80586 or equivalent
b) 80686 or equivalent

5.7.3 The microprocessor unit shall operate with an external clock rate of 266 MHz or greater.

5.7.4 The CPUA shall be supplied with a minimum of 256 MB of static or dynamic RAM.

5.7.5 The CPUA shall be equipped with a battery-backed real-time clock. The clock shall utilize CMOS technology for low power consumption during power down mode. The ATC shall be supplied with the real-time clock battery disconnected. If the battery is external to CPUA, it shall be mechanically fastened to the card cage sub rack. The use of a strap or tie wrap is acceptable. Other methods of fastening will be considered, subject to the Ministry's approval. The clock shall include the following features:

a) time of day and date counter (year, month, week, day)
b) built-in quartz oscillator
c) capable of providing the CPU with a periodic tick at millisecond resolutions

5.7.6 The CPUA shall contain a minimum of two RS-232 DTE serial ports each terminated by a DB9 male connector. Each serial port shall be software configurable for standard data rates from 2,400 to 115,000 baud; five to eight data bits; one or two stop bits; and even, odd or no parity bit. Each serial port shall be capable of full-duplex operation and shall support RTS-CTS handshaking.

5.7.7 The CPUA shall contain a minimum of two USB 2.0 compliant ports terminated by a USB "A" female connector with current limiting and QNX 6.3 driver support. Any additional optional USB ports shall be terminated by a USB "A" female connector with current limiting.

5.7.8 The CPUA shall provide VGA video with QNX 6.3 driver support.

5.7.9 CPUA shall be shipped and supported by the latest full run-time version of the QNX version 6.3 (or latter) operating system. All applicable licences shall be provided to support the following functional requirements: Runtime kernel and all QNX utilities, TCP/IP networking, FTP server, Telnet server, HTML server, USB flash disks and USB CDROMs.

5.7.10 CPUA BIOS shall support boot up and IDE emulation for a single externally removable CompactFlash memory card up to 1GB capacity.

5.7.11 CPUA CompactFlash memory card socket shall support both CompactFlash type 1 and type 2 memory cards.

5.7.12 The ATC shall be supplied with a 1GB (or larger) CompactFlash memory card and shall be pre-configured to self-boot into QNX 6.3 with a serial login shell started on serial port 1. If supported by CPUA, serial port 1 shall be configured to be a console port using 9600 baud, 8 data bits, 1 stop bit and no parity.

5.7.13 The CPUA shall be supplied with a complete memory map specifying address ranges for all RAM and ROM devices.

5.8 Digital I/O

5.8.1 General

5.8.1.1 The ATC shall be provided with a minimum of 44 digital inputs and 16 digital outputs and shall be terminated in the C1 connector, as per attachment 1.

5.8.1.2 The input and output modules shall be capable of operating at a minimum of 2 Kilohertz. Although it is not a requirement, optically isolated digital input and output interface is preferred.

5.8.2 Digital Input Requirements

5.8.2.1 The input interface module shall provide a minimum of 44 digital input interfaces. Digital inputs shall be referenced in groups of 8-bit words. Thus, as a minimum, the digital input module shall comprise 6 groups of 8-bit gated inputs. The inputs shall all be of a consistent type; either inverted or non-inverted.

5.8.2.2 Inverted inputs shall operate by presenting a logic low to the CPU assembly when the input is open and shall present a logic high to the CPU assembly when the input voltage is less than 2.0 volts, or when the input is grounded.

5.8.2.3 Non-inverted inputs shall operate by presenting a logic high to the CPU assembly when the input is open and shall present a logic low to the CPU assembly when the input voltage is less than 2.0 volts, or when the input is grounded.

5.8.2.4 An input shall not deliver in excess of 20 milliamperes to a short circuit to logic level common.

5.8.2.5 When the CPU assembly requests a read on a group of inputs (8 bits), the input interface module shall present the appropriate data on the data bus. The input interface module shall not change the state of the input bits of a group presented to the CPU assembly during a read cycle.

5.8.2.6 The input circuitry should internally contain pull up resistors, to a suitable voltage, for each digital input. If supplied on-board by the manufacturer, the internal pull up shall be at least 5 volts through a minimum of 4.7 k resistance. Alternatively, the pull ups can be accomplished externally. Each input pulled up externally shall accept a pull up to 24 volts through a minimum of 4.7 k resistor. Internal pull up is desired. Consideration shall be given first to ATC units which provide internal pull ups on all digital input lines.

5.8.3 Digital Output Requirements

5.8.3.1 The output interface module shall provide a minimum of 16 digital output interfaces. All digital outputs shall be latched at the time of writing by the CPU assembly. All digital outputs shall comprise an NPN open collector output capable of driving up to 40 VDC and sinking up to 100 milliamperes. The outputs shall all be of a consistent type; either inverted or non-inverted.

5.8.3.2 Inverted outputs shall operate by presenting a grounded collector at the C1 connector output when a logic high is written to the output by the CPU assembly. Inverted outputs shall operate by presenting an open collector at the C1 connector output when a logic low is written to the output by the CPU assembly.

5.8.3.3 Non-inverted outputs shall operate by presenting a grounded collector at the C1 connector output when a logic low is written to the output by the CPU assembly. Non-inverted outputs shall operate by presenting an open collector at the C1 connector output when a logic high is written to the output by the CPU assembly.

5.8.3.4 The rise and fall times of the output signal shall be less than 0.5 microseconds (0.1% of 1/2000 Hz).

5.8.3.5 Once a port of the output module has been written to, the data shall remain present and stable until either the port is written to again, or the ATC power is removed.

5.8.3.6 All outputs shall be in an open circuit state (i.e. off) at the time of power up.

5.9 Closed Circuit Camera I/O

5.9.1 General

5.9.1.1 The ATC shall be provided with high voltage digital outputs and analog inputs described below to provide full control of all closed circuit camera motors and feed-back capabilities. All I/O shall be terminated in either the C2 connector or a terminal block, as per attachment 2. The outputs will be used to switch both 120 VAC and +/- 12 VDC for closed circuit camera pan, tilt, zoom and focus motors. The analog inputs shall provide camera pan, tilt, zoom and focus position feed back voltage readings from -10 VDC to +10 VDC.

5.9.1.2 All Closed Circuit Camera I/O shall be optically isolated to provide a minimum of 4000 V RMS isolation. All dc outputs used for motor and feed back purposes shall be supplied by a separate power supply.

5.9.1.3 The ATC hardware shall implement the following mutually exclusive closed circuit camera output logic: pan left/right, tilt up/down, zoom in/out, focus in/out.

5.9.1.4 All digital outputs shall be latched at the time of writing by the CPU assembly. The outputs shall all be of a consistent type; either inverted or non-inverted. The rise and fall times of the output signal shall be less than 10 milliseconds.

5.9.1.5 All outputs shall be in an open circuit state (i.e. off) at the time of power up.

5.9.2 120 VAC Outputs

5.9.2.1 The Closed Circuit Camera I/O interface module shall provide 4 optically isolated high voltage 120 VAC outputs, in two groups, pan and tilt. Each group shall have a front panel accessible 7 amp slow blow fuse or equivalent circuit breaker to protected from short circuits and overloads. Each output shall have a minimum current rating of 4 Amps. The hardware shall be capable of concurrently driving two 4 Amp loads, one from each output group.

5.9.3 12 VDC Outputs

5.9.3.1 The Closed Circuit Camera I/O interface module shall provide 4 optically isolated high voltage +/- 12 VDC outputs, in two groups, zoom and focus. All DC outputs shall be suitably protected from short circuits and overloads. Each output shall have a minimum current rating of 100 milliamperes. The hardware shall be capable of concurrently driving two 100 milliamperes loads, one from each output group. The +/- 12 VDC outputs shall not be supplied by the CPU sub-rack power supply.

5.9.4 Analog Inputs

5.9.4.1 The Closed Circuit Camera I/O interface module shall provide 4 optically isolated analog inputs and provide a minimum of 12 bit resolution analog to digital conversion with a range of from -10 VDC to +10 VDC. The minimum resolution shall be 6 milli volts. Additional analog side isolation shall be incorporated to protect all four analog to digital circuitry to a minimum of 2500 Vrms. Concurrent reading of all 4 analog inputs is preferable, but not required.

5.9.4.2 Full scale accuracy at 25^{o} C shall be 1% minimum, with a maximum response time of 10 milliseconds.

5.9.4.3 Other implementations of analog inputs to digital conversion will be considered, subject to the Ministry’s approval.

5.10 Network Adaptor

5.10.1 Each ATC unit shall provide an Ethernet adapter card. The adaptor may be integrated into the CPU assembly or connected to the backplane. The adapter shall conform to IEEE 802.3 and Ethernet standards for both 10 Mbps and 100 Mbps Carrier Sense Multiple Access/Collision Detection (CSMA/CD) local area network. The Ethernet adapter card shall support 10/100-base-T. Any adopters or transceivers required shall be supplied.

5.10.2 Intermediate cable shall be installed from the Ethernet adapter card to the rear of the custom chassis for both 10/100-base-T. The cable shall be suitable shielded and comply with category 5 requirements. The rear chassis cable termination connectors shall be RJ-45 for 10/100-base-T.

5.10.3 The adapter shall be fully supported and supplied with appropriate QNX 6.3 drivers.

5.11 Custom Enclosure

5.11.1 The custom enclosure shall be a compact, durable, portable, sealed metal enclosure suitably protected against environmental corrosion. There shall be no convection cooling ventilation openings. Internal extended life ball bearing forced air cooling systems shall be employed as necessary to guarantee unit operation within the environmental requirements of this Special Provision. The enclosure shall mount or be supplied with suitable brackets for a standard EIA 480mm rack with standard EIA open end mounting slots.

5.11.2 The maximum enclosure dimensions (regardless of PCB form factor) shall not exceed 178 mm (7 inches) in height, 432 mm (17 inches in width) and 356 mm (14 inches) in depth. The enclosure with all hardware installed shall not weigh more than 10 kg. The front panel enclosure material shall be a minimum of 2.28 mm (0.090 inches) thick and suitably secured to support the entire enclosure weight when rack mounted. All other enclosure material shall be a minimum of 1.27 mm (0.050 inches) thick and suitably secured to other panels. The enclosure seams shall be flush with no unfinished edges. Special care shall be taken to ensure proper grounding of all enclosure panels.

5.11.3 Each ATC shall be supplied with an external category 5 10/100-base-T patch cable (RJ-45 to RJ-45) with a minimum length of 1.0 metre.

5.11.4 The custom enclosure shall have the following front panel terminations:

a) Serial port 1, labelled “Maintenance Port” DB9 male with industry standard screw fastener (nut);
b) Two USB “A” female connectors, labelled “Keyboard” and “Mouse”;
c) VGA port, female DB15 labelled “ Monitor” with industry standard screw fasteners (nut);
d) Memory card access panel with captive thumb screws;
e) Main AC power on/off switch;
f) Three quick removable AC supply fuses or equivalent;
g) Power on LED, powered by the CPU sub-rack power supply;
h) CPU Activity/Status LED, controlled by software;
i) Power supply test points for both power supplies, female "banana" type jacks;
j) Standard rack-mount handles;
k) Manufacturer name, model, and serial number label.

5.11.5 The custom enclosure shall have the following rear panel terminations:

a) Serial port 2, labelled “COM 2”, DB9 male with industry standard screw fastener (nut);
b) Any additional optional USB “A” female connector labelled “USB”;
c) AMP 205720-2 or equivalent female 104-pin C1 digital I/O connector with corrosion resistant guide pins and sockets, as per attachment 1;
d) AMP 206043-1 or equivalent female 14 pin C2 I/O connector with # 18 AWG wiring to high voltage output interface, as per attachment 2;
e) Low voltage camera control terminal strip with labels for “Zoom”, “Ground”, Focus”, “Position +”, Position –“, “Focus Position”, “Position Ground”, “Zoom Position”, as per attachment 2;
f) Standard computer style 3-prong male AC power receptacle located on the lower left side;
g) Female RJ-45 LAN connector labelled “LAN”, with Category 5 internal cabling;
h) Feet or reset rear panel to protect all rear panel connectors;
i) Serial number label.

5.11.6 All front and rear panel connectors shall be screw fastened with a lock washer and/or locking compound. The front and rear faceplate markings shall be silk-screened or equivalent to provide a permanent professional appearance. Final connector layout drawings and markings shall be reviewed and approved by the Ministry before they are manufactured.

5.11.7 The custom enclosure shall contain a card cage sub rack comprising of one of the following: PC/104, PC/104-Plus, or PCI. Other industry standard Backplane buses architectures will be considered, subject to the Ministry’s approval. The Backplane shall provide a minimum of two spare slots when the ATC is fully equipped as defined by this Special Provision.

5.11.8 The chassis and power supplies shall operate properly according to the electrical and environmental requirements detailed in this Special Provision.

5.11.9 All chassis assembly and hardware shall be screw fastened with a lock washer and/or locking compound.

5.11.10 Each ATC shall be supplied with an external removable three conductor AC power cable. The AC power cable shall be a minimum of 1 meter in length. The cable shall be a standard computer style 3-prong female plug to NEMA Type 5-15P or equivalent grounding male plug.

5.12 Power Supplies

5.12.1 General

5.12.1.1 Separate power supply units are required for the sub-rack, and the +/- 12 VDC camera control digital outputs. Both power supply units shall be UL and CSA approved.

5.12.1.2 The power supply units shall operate properly with an input AC voltage of 115 +/- 10 VAC at 60 +/- 3 Hz.

5.12.1.3 Each power supply unit shall be easily removable. All components of each power supply, including line filtering and regulating components, shall be mounted within a single power supply module.

5.12.1.4 The power supply units shall be at least 80% efficient at 20^{o} C. The power supply units shall be designed such that all components of the power supply operate at or below 80% of their maximum rating.

5.12.1.5 Power supply wires distributing DC voltages throughout the ATC unit shall be kept to a minimum length, and shall be twisted at least 30 turns per meter. Wire shall be stranded, and shall be of sufficient gauge to provide the current carrying capacity necessary for its function.

5.12.2 CPU Sub Rack Power Supply

5.12.2.1 The CPU Sub Rack power supply unit shall provide the proper outputs required by the installed Backplane subrack. This unit shall produce enough power to drive a fully loaded subrack. The front panel power on LEDs shall be driven by this power supply.

5.12.2.2 The CPU Sub Rack power supply unit +5 VDC voltage measured at the front panel banana jacks shall not drift more than +/- 2% over a 48 hour burn-in period at room temperature (+ 22^{o} C +/- 15%).

5.12.2.3 The CPU Sub Rack power supply unit +5 VDC voltage measured at the front panel banana jacks shall not drift more than +/- 2% over the fully operating temperatures specified in section 5.6.1 of this Special Provision.

5.12.2.4 The CPU Sub Rack power supply unit +5 VDC voltage measured at the front panel banana jacks shall not drift more than +/- 2% when the ATC unit is first energized after being non-energized for a 4 hours cold temperature soak at the lowest operating temperature specified in section 5.6.1 of this Special Provision.

5.12.2.5 The CPU Sub Rack power supply unit +5 VDC voltage measured at the front panel banana jacks shall not drift more than +/- 2% when the ATC unit is first energized after being non-energized for a 4 hours hot temperature soak at the highest operating temperature specified in section 5.6.1 of this Special Provision.

5.12.3 Camera Control Digital Output DC Power Supply

5.12.3.1 Camera Control Digital Output DC Power Supply unit shall provide +12 VDC and -12 VDC. This unit shall produce enough power to drive up to a 0.5 Amp load on each of the +12 VDC and -12 VDC terminals at the same time.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation

7.1.1 The ATC equipment shall be installed only in the racks or jacks intended for use with the particular item of equipment. Equipment shall be installed within the guide provided and shall be set snug so as to lock into any motherboard, channel or connection specified.

7.1.2 ATCs shall not be installed in cabinets until AC power supply has been connected to cabinets, and fans and heaters are functional. ATCs shall be installed and energized within 48 hours of shipment from the place of storage. ATC units shall be left in the ‘on’ position.

7.1.3 Workmanship shall be in accordance with the highest industry standards. ISO 9000 registration is preferred but not required.

7.1.4 All assemblies shall be mechanically secured to retain the assemblies and their associated devices in the proper position under conditions of shock and vibration.

7.1.5 All wiring terminated in a terminal block shall utilize an appropriate size fork connector. All crimped stranded wires shall first be tinned with solder. All connectors shall be protected with a non-conductive sleeve or heat shrink material.

7.1.6 The Contractor shall energize each unit and confirm proper operation by visual inspection.

7.1.7 The Contractor is required to perform quality control testing on 100% of the ATCs prior to delivering the ATCs. The Contractor shall test each ATC to confirm that it meets the requirements of the Contract, including:

a) Board level and system diagnostics;
b) Loop-back tests for all C1 digital I/O pins;
c) Camera control tests including AC and DC loading and analog feedback verification;
d) Ethernet LAN ping test using both 10-base-T and 100-base-T;
e) 48 hour system burn-in.

7.1.8 The Contractor shall verify that the controller performs to the specified standards when used in operation with cabinets, detector sensor units, actuation devices, cameras, pan/tilt units and communication equipment installed under the Contract, and existing subsystems or components such as communications, central computer, central software and actuation devices.

7.1.9 All components and assemblies shall be subjected to a decrease in ambient temperature from 20^{o} C to – 30^{o} C at a rate of not more than 18^{o} C per hour. All components and assemblies shall continue proper operation at - 30^{o} C for a minimum period of 5 hours. Power shall then be removed for a minimum period of 2 hours and then restored. All components and assemblies shall restart proper operation at - 30^{o} C for a minimum period of 2 hours, then continue proper operation when returned to 20^{o} C at the same rate. The above test shall be performed with line voltages within 105 VAC and 125 VAC.

7.1.10 All components and assemblies shall be subjected to an increase in ambient temperature from 20^{o} C to 65^{o} C at a rate of not more than 18^{o} C per hour. All components and assemblies shall continue proper operation at 65^{o} C for a minimum period of 5 hours. The components and assemblies shall continue proper operation when returned to 20^{o} C at the same rate. The above test shall be performed with line voltages within 105 VAC and 125 VAC.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.3.2	√		
5.1.3.5	√		
5.1.3.6	√		
5.1.3.7	√		
5.1.3.9	√		
5.1.3.10	√		
5.5.1	√	√	
5.7.4	√		
5.7.6	√		
5.7.7	√		
5.9.1.1	√	√	√
5.9.1.3	√	√	

CLAUSE	PIT	POP	SIT
5.10.1	√		
5.11.3	√		
5.11.4	√		
5.11.5	√		
5.11.10	√		
5.12.2.2	√		
5.12.2.3	√		
5.12.2.4	√		
5.12.2.5	√		
7.1.8	√	√	
7.1.9	√		
7.1.10	√		

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of advanced traffic controllers (ATC) installed is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including the production of all drawings, text and test results, except SIT which is paid for under a separate item.

ATTACHMENT 1

C1 Pinout Requirements

Input Assignments		Output Pin Assignments		Other	
Input	C1 Contact	Output Group	C1 Contact	Function	C1 Contact
102H, bit 7	39	108H, bit 7	2	ground	1*
102H, bit 6	40	108H, bit 6	3	ground	14*
102H, bit 5	41	108H, bit 5	4	ground	92*
102H, bit 4	42	108H, bit 4	5	ground	104*
102H, bit 3	43	108H, bit 3	6	*Note All 4 ground pins are to be connected to each other to prevent ground loops.	
102H, bit 2	44	108H, bit 2	7		
102H, bit 1	45	108H, bit 1	8		
102H, bit 0	46	108H, bit 0	9		
101H, bit 7	47	109H, bit 7	10		
101H, bit 6	48	109H, bit 6	11		
101H, bit 5	49	109H, bit 5	12		
101H, bit 4	50	109H, bit 4	13		
101H, bit 3	51	109H, bit 3	15		
101H, bit 2	52	109H, bit 2	16		
101H, bit 1	53	109H, bit 1	17		
101H, bit 0	54	109H, bit 0	18		
100H, bit 7	55	n/c	19		
100H, bit 6	56	n/c	20		
100H, bit 5	57	n/c	21		
100H, bit 4	58	n/c	22		

100H, bit 3	59	n/c	23		
100H, bit 2	60	n/c	24		
100H, bit 1	61	n/c	25		
100H, bit 0	62	n/c	26		
106H, bit 7	N/C	n/c	27		
106H, bit 6	N/C	n/c	28		
106H, bit 5	N/C	n/c	29		
106H, bit 4	N/C	n/c	30		
106H, bit 3	63	n/c	31		
106H, bit 2	64	n/c	32		
106H, bit 1	65	n/c	33		
106H, bit 0	66	n/c	34		
105H, bit 7	67	n/c	35		
105H, bit 6	68	n/c	36		
105H, bit 5	69	n/c	37		
105H, bit 4	70	n/c	38		
105H, bit 3	71	n/c	100		
105H, bit 2	72	n/c	101		
105H, bit 1	73	n/c	102		
105H, bit 0	74	n/c	103		
104H, bit 7	75	n/c	83		
104H, bit 6	76	n/c	84		
104H, bit 5	77	n/c	85		
104H, bit 4	78	n/c	86		

104H, bit 3	79	n/c	87		
104H, bit 2	80	n/c	88		
104H, bit 1	81	n/c	89		
104H, bit 0	82	n/c	90		
		n/c	91		
		n/c	93		
		n/c	94		
		n/c	95		
		n/c	96		
		n/c	97		
		n/c	98		
		n/c	99		

ATTACHMENT 2

High Voltage Digital Output Terminations

C2 Pinout Requirements

Function	Pin	Function	Pin	Function	Pin
Tilt Common	1	Tilt Up (120 VAC)	2	Tilt Down (120 VAC)	3
Pan Common	4	Pan Right (120 VAC)	5	Pan Left (120 VAC)	6
Ground	7	Reserved	8	Tilt Position +	9
Position Supply +12VDC	10	Pan Position +	11	Position Supply -12 VDC	12
N/C	13	Guide Pin Only (N/C)	14		

Terminal Block # 1 Wiring Requirements

Function	#	Function	#	Function	#
Zoom (+12 or -12 VDC)	1	±12 VDC Ground	2	Focus (+12 or -12 VDC)	3
Position Supply+12VDC	4	Position Supply -12VDC	5	Focus Position	6
Position Ground	7	Zoom Position	8		

WARRANT: All ATMS Contracts with this item.

LOOP VEHICLE DETECTOR SENSOR UNITS - Item No.

Special Provision No. 682S18 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of loop vehicle detector sensor units.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 622 Installation of Traffic Signal Controllers

Ministry of Transportation Publications:

Ontario Traffic Signal Control Equipment Specifications (OTSCES)

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the loop vehicle detector sensor units to the Contract Administrator prior to ordering.

5. MATERIALS

5.1 Loop vehicle detector sensor units shall be Model 222, 222B or 422 and shall meet the requirements of applicable Ontario Traffic Signal Control Equipment Specifications (OTSCES) and all applicable addenda.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The Contractor shall install vehicle detector sensor units in accordance with the requirements of OPSS 622 and as indicated in the drawings. Detector cables shall be connected to sensor units such that loops in adjacent lane locations are connected in reverse winding directions (clockwise, counter-clockwise, clockwise, etc.).

7.2 Upon connection of loop detector cables, the Contractor shall calibrate the sensor units. A minimum of two members of the Contractor's staff shall be dedicated to this work. The Contract Administrator shall witness the calibration. Forty-eight (48) hours advance notice for this work shall be provided. Each vehicle sensor unit shall be calibrated for 2 minutes. The Contractor shall tune the sensor units to a frequency and sensitivity setting giving the best response to various types of vehicles using visual confirmation. Following the calibration the Contractor shall confirm proper operation of the sensor units at the controller using Owner supplied GRID software. Each sensor unit shall be monitored through the GRID software for minimum of 5 minutes.

7.3 Following successful calibration of the sensor units, the Contractor shall obtain confirmation from the Contract Administrator that the data from the loop vehicle detector sensor units is reported by at the TOC.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1	√		
7.1		√	
7.2		√ [1]	
7.3			√

Testing Footnotes:

[1] GRID software report shall be submitted as part of test results documentation.

8. QUALITY ASSURANCE - Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of loop vehicle detector sensor units is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work, except System Integration Testing which is paid for under a separate item.

NOTES TO DESIGNER:

1. Include this tender item in all Contracts that require replacement of existing Loop Detectors. Modify Section 1. Scope accordingly.

WARRANT: Always with this item.

ATMS LOOP DETECTORS - Item No.
ATMS LOOP DETECTORS (TEMPORARY) - Item No.

Special Provision No. 682S19 July 2009

Amendment to OPSS 623, January 1990

623.05 MATERIALS

623.05.01 Cables

Subsection 623.05.01 of OPSS 623 is amended by the addition of the following paragraph:

Where it is required to cut loops during darkness, the Contractor may use white insulated cable for visibility purposes.

623.07 CONSTRUCTION

623.07.01.02 Saw Cutting

Clause 623.07.01.02 of OPSS 623 is amended by the addition of the following:

623.07.01.02.01 Saw Cutting in New Flexible Pavement

If staging permits, the saw cuts shall be in the lower binder course or milled surface. If staging does not permit, the saw cuts shall be in the upper binder course. Construction of saw cuts in the surface course shall not be permitted.

623.07.01.02.02 Saw Cutting in New Composite Pavement

The saw cuts shall be constructed in the binder course. Saw cutting in composite pavement will only be allowed in locations where binder course pavement is minimum 75mm deep to avoid cutting into the concrete surface. Construction of saw cuts in the surface course shall not be permitted.

623.07.01.04 Flexible Duct Installation

Clause 623.07.01.04 of OPSS 623 is deleted and replaced with the following clause:

623.07.01.04 Installation of Rigid PVC Duct with Flexible Duct End

For loops installed under Selective Resurfacing Contracts, a hole shall be drilled through the pavement to accommodate a rigid PVC duct complete with flexible duct end at the location indicated in the Contract.

For loops installed under Capital Contracts, the rigid PVC conduits shall be installed as indicated in the Contract by excavation of the shoulder, backfill and compaction with Granular ‘A’ and restoration of the shoulder pavement.

All work for rigid duct installation, including earth excavation, backfill, removal and restoration, shall conform to OPSS 603.

All work for Granular 'A' shall conform to OPSS 314.

All work for restoration of the shoulder pavement shall conform to OPSS 313.

623.07.01.05 Loop Cable

Clause 623.07.01.05 of OPSS 623 is amended by the deletion of the last paragraph and addition of the following:

The Contractor shall identify each loop with a permanent vinyl sleeve wire marker at the splice point. Each loop shall be labelled as shown on the layout drawings, for example, No. 1, No. 2, No. 3 - etc. Each loop detector station shall be identified by installing a nameplate on the inside wall of the splice point where the loop wires enter the splice point. The nameplate shall be visible from above when the splice point cover is removed. Nameplates shall be fastened to the wall using concrete anchors. Nameplates shall be laminated phenolic plastic, black with white core. Lettering shall be 13 mm high and shall identify the full loop station identifier as indicated on the drawings. The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates.

Loop locations shall be accurately marked with a cut cross on pavement as indicated in the detail drawings.

623.07.01.06 Sealant

Clause 623.07.01.06 of OPSS 623 is amended by the addition of the following:

The Contractor shall install loop wires and place the required sealant during the same working period that sawcuts are made in road surface. No traffic is allowed over the area until the installation is complete and the sealant has hardened in accordance with the manufacturer's instructions. This operation shall not take place during periods when the ambient temperature is below 0^{o}C.

623.07.01.07 Splicing

Clause 623.07.01.07 of OPSS 623 is amended by addition of the following:

The Contractor shall notify the Contract Administrator 24 hours prior to splicing of loop cable and the extra low voltage lead in cables.

Subsection 623.07.01 is amended by the addition of the following clause:

623.07.01.08 Disconnection/Reconnection of Existing Loops

When milling work will impact loop detectors and cables that lead to loop detectors, these cables/loops shall be disconnected at the roadside electrical chambers prior to milling operations. Milling shall be to the full width of the pavement in the loop detector location. Upon reinstallation, the cables/loops shall be reconnected by the Contractor in accordance with the Contract requirements.

Section 623.07 of OPSS 623 is amended by addition of the following subsection:

623.07.05 Quality Control

The framework of the approval process shall be as specified elsewhere in the Contract Documents.

Proof of Performance Testing

Testing of loops shall be done at the roadside chamber prior to splicing the home run cables and sealing the slots and after splicing of the home run cables. Testing shall be witnessed by the Contract Administrator. The Contractor shall provide 24 hours notice to the Contract Administrator prior to undertaking testing.

System Integration Testing

The Contractor shall carry out system integration testing to ensure that the detector loops perform to the specified standards when operated with detector sensor units and controllers.

Upon connection of loop detector cables, the Contractor shall calibrate the sensor units. A minimum of two members of the Contractor's staff shall be dedicated to this work. The Contract Administrator shall witness the calibration. Forty-eight (48) hours advance notice for this work shall be provided. Each vehicle sensor unit shall be calibrated for 2 minutes. The Contractor shall tune the sensor units to a frequency and sensitivity setting giving the best response to various types of vehicles using visual confirmation. Following the calibration the Contractor shall confirm proper operation of the sensor units at the controller using Owner supplied GRID software. Each sensor unit shall be monitored through the GRID software for minimum of 5 minutes.

623.09 MEASUREMENT FOR PAYMENT

623.09.02.01 Loop Detectors
Probe Detectors
Pedestrian Pushbuttons

Clause 623.09.02.01 of OPSS 623 is amended by the addition of the following:

ATMS Loop Detectors
ATMS Loop Detectors (Temporary)

623.10 BASIS OF PAYMENT

623.10.01 Loop Detectors – Item
Probe Detectors – Item
Pedestrian Pushbuttons – Item
Traffic Actuation Equipment Lump Sum – Item

Subsection 623.10.01 of OPSS 623 is amended by the addition of the following:

ATMS Loop Detectors - Item
ATMS Loop Detectors (Temporary) -Item

WARRANT: All ATMS Contracts with these items.

<u>TEST EXISTING LOOP DETECTORS</u> - Item No.

Special Provision No. 682S20 September 2007

1. SCOPE

This Special Provision covers the requirements for the locating and testing of existing loop detectors installed under previous Contracts.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 623 Traffic Actuation Equipment

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS – Not Used

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

The Contractor shall disconnect the existing loop feeders /home run cables in the electrical chamber prior to the milling operations.

The Contractor shall locate the loop leads at the existing splice point. Where loops are connected to existing detector cables, the splices shall be removed and later reinstated in accordance with the requirements of OPSS 623.

Loops shall be tested in accordance with the requirements of OPSS 623.

Where loops were previously installed without identification markers or nameplates, these items shall be installed in accordance with the requirements of the Special Provision for the Contract item “Loop Detectors”. This requirement applies to all existing loops.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for the testing of existing loop detectors is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work. Such payment shall include compensation for locating all loops and splice points, testing, recording test results, reconnection of loop cables to detector cables where required and identification of loop cables at splice points where required.

WARRANT: All Contracts with this item.

REMOVAL OF ADVANCED TRAFFIC MANAGEMENT SYSTEM EQUIPMENT - Item No.

Special Provision No. 682F22 February 2009

Amendment to OPSS 610, November 2008

610.07 CONSTRUCTION

Section 610.07 of OPSS 610 is amended by the addition of the following subsection:

610.07.13 Advanced Traffic Management System Equipment

The Contractor shall submit a detailed equipment removal plan with detailed schedule and procedures for review and approval to the Contract Administrator 2 weeks prior to commencing any removal work.

Prior to removal operations, the Contractor shall test and inspect all equipment to be salvaged. The Contract Administrator will witness all tests and inspections. The Contractor shall provide 24 hours advance notice of this work to the Contract Administrator.

The following test and/or inspections shall be performed for equipment to be salvaged under this Contract: *

Equipment	Test / Inspection Details

The following equipment shall be removed and salvaged for delivery/storage as indicated: **

Description	Quantity	Delivery / Storage Location

The following equipment shall be removed and salvaged for re-installation under this Contract. A temporary storage location with regulated environmental controls to meet the manufacturers storage requirements shall be utilized when equipment cannot be re-installed and re-energized during the same working day as removal: ***

Description	Quantity	Temporary Storage Location

The Contractor shall deliver the above equipment to and from the Contract site if temporary storage is required.

All remaining equipment identified for removal shall become the property of the Contractor and shall be managed in accordance with OPSS 180.

Where the Owner's premises are required for delivery and/or storage, the Contractor shall provide 72 hours notice to the Contract Administrator prior to delivery and/or pickup. The delivery and/or pickup from Owner's premises shall be made between 7:00 am and 3:00 pm Monday through Friday.

610.10 BASIS OF PAYMENT

Section 610.10 of OPSS 610 is amended by the addition of the following subsection:

610.10.02 Removal of Advanced Traffic Management System Equipment - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work.

NOTES TO DESIGNER:

* List all tests required to be performed on salvaged equipment prior to removal. Fill-in table size is reduced. Add rows as required.

** Provide description and quantity of equipment to be salvaged and delivery/storage location. Fill-in table size is reduced. Add rows as required.

*** Provide description and quantity of equipment to be salvaged for re-installation and temporary storage location if necessary. Fill-in table size is reduced. Add rows as required.

WARRANT: Always with this item

<u>INNER CHAMBERS</u> - Item No.

Special Provision No. 682S23 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation of inner chambers within rigid ducts to divide the space within the duct into separate compartments.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the inner chambers to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Inner chambers

The inner chambers shall be made of material suitable for installation in underground and surface mounted ducts.

The inner chambers shall provide individual compartments suitable for the installation of fibre optic and other cables.

The inner chambers shall be flexible and resist cracking to a low temperature of – 40^{o} C.

The inner chambers shall be sufficiently rigid to maintain the internal shape of each chamber around conduit bends.

The inner chambers shall be supplied on cable reels in a manner to allow for the simultaneous installation of all individual chambers.

The inner chambers shall be supplied in sufficient lengths to allow installation between pull points without the need for intermediate joints.

5.2 Fish Line

Fish line shall be nylon or polypropylene material with minimum test strength of 400 N.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Inner chambers

The Contractor shall install inner chambers as shown in the Contract Documents at the locations and in quantities shown in the Contract. The number and sizes of inner chambers per duct shall be as indicated in the Contract.

Care shall be taken at all times to avoid denting or otherwise damaging the inner chambers before, during and after installation. Damaged inner chambers shall be replaced by the Contractor without additional compensation.

Inner chambers shall be installed in the ducts prior to the installation of any cables.

The Contractor shall install the inner chambers for each duct simultaneously, as one unit.

The inner chamber manufacturer's recommended lubricant shall be applied to the inner chambers to reduce friction between the inner chamber and the duct.

Inner chambers shall be installed in continuous lengths between all pull points (pedestals, communications boxes, electrical chambers). Intermediate joints or connections in the inner chambers between pull points shall not be permitted.

The Contractor shall cut the inner chambers at each pull point and shall leave a minimum of 150 mm of each inner chamber extending beyond the opening of the main duct. All rough edges shall be smoothed to prevent cable damage during and after the installation of the cable.

Each inner chamber shall be distinguishable by means of a consistent colour coding scheme utilizing coloured plastic disks on each end of the inner chamber at all pull points. The coloured disks shall be attached to the inner chamber with nylon tie wraps.

A test mandrel shall be pulled through all inner chambers to verify the integrity of the entire inner chamber system.

The Contractor shall install a fish line in all inner chambers for future cable installation.

All unused inner chambers shall be sealed at every opening with plastic conduit end caps.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for inner chambers is by Plan Quantity as may be revised by Adjusted Plan Quantity of the horizontal length in metres, along the longitudinal axis of the inner chambers. Measurement will be from end to end of ducts where the ducts terminate in a structure or from centre to centre of pedestals, communications boxes, electrical chambers, and to the face of bridge structures and retaining walls. For installation in surface mounted ducts, measurement will be made along the axis of the ducts including junction boxes from one point of attachment to other points of attachment.

The unit of measurement is metre.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work.

WARRANT: All Contracts with this item.

CONCRETE FOOTINGS IN EARTH– Item No.

Special Provision No. 682S25 February 2009

Amendment to OPSS 616, November 2008

616.01. SCOPE

Section 616.01 of OPSS 616 is deleted and replaced with the following:

This Special Provision covers the requirements for the installation of concrete footings for base mounted communication pedestals complete with cable entry ducts as shown in Contract Drawings.

616.07. CONSTRUCTION

616.07.03.02.01 Sleeves and Ducts

Clause 616.07.03.02.01 of OPSS 616 is amended by addition of the following:

Ducts shall be oriented to suit entry and exit from the nearby trench and to suit entry to the nearby cabinet pad and electrical chamber. Conduit orientation must conform to the Contract Drawings.

616.07.03.02.02 Anchorage Assemblies

Clause 616.07.03.02.02 of OPSS 616 is deleted.

WARRANT: All ATMS Contracts with this item.

<u>NON-INTRUSIVE TRAFFIC SENSORS (Microwave)</u> – Item No.

Special Provision No. 682S26 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation, calibration, integration and testing of Non-Intrusive Traffic Sensor (NITS) units. The NITS units shall be used for traffic flow monitoring during construction. As a condition of acceptance of this item, the Contractor shall ensure that the NITS traffic data is received at TOC central computer system.

Where specified in the Contract, the NITS units shall be supplied integrated with spread spectrum radio equipment and solar power supply.

Unless otherwise noted in the Contract, the NITS units shall be removed and delivered to the Owner at the completion of the Contract.

2. REFERENCES

This Special Provision refers to the following standards and specifications:

Ontario Provincial Standard Specifications, Construction:

OPSS 609 Grounding

Canadian Standards Association:

CSA C22.2 No. 65-93 Wire Connectors

Electronic Industries Alliance / Telecommunication Industry Association:

TIA/EIA-195C	Electrical and Mechanical Characteristics for Terrestrial Microwave Relay System Antennae and Passive Reflector
EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit Terminating Equipment Employing Serial Binary Data Interchange

National Electrical Manufacturers Association (NEMA):

NEMA 250-1997 Enclosures for Electrical Equipment (1000 Volts Maximum)

Industry Canada:

IC RSS 210	Industry Canada Radio Standards Specification Low-power Licence Exempt Radio Communication Devices
ICES-003	Interference-Causing Equipment Standard for Digital Apparatus, Issue 4

Other:

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Radio Frequency (RF): means electromagnetic energy with frequencies ranging from 3 kHz to 300 GHz. Microwaves are a span of radio frequencies extending from 300 MHz to 300 GHz.

RF equipment: means a device that generates a signal within a radio frequency bandwidth

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit the specification sheets for the NITS, RF equipment, solar power supply, cable and associated components as applicable, to the Contract Administrator for review prior to ordering. The submission shall include written procedures for preparation and connectorization of interconnect cables and compliance with Industry Canada regulations for NITS and RF equipment.

5. MATERIALS

5.1 NITS Units

5.1.1 NITS units shall provide monitoring of traffic conditions for the traffic lanes as indicated in the Contract Drawings. The following parameters of the traffic flow shall be measured for each lane:

a) Volume (with accuracy ± 5%)
b) Occupancy (with accuracy of ± 5%)
c) Speed (with accuracy ±10%)

The accuracies specified shall apply to a vehicle speed range of 50-120 km/h for detection zone range of 3-60 m.

5.1.2 The NITS units shall integrate with the ATC hardware, software and the central computer system currently used by the Owner, to provide the above traffic data at the Traffic Operations Centre. The ATC protocol will be made available to the Contractor upon request.

5.1.3 The NITS shall be approved for licence free operation in Canada. The NITS units shall not cause interference or be susceptible to interference from any radiating system. The NITS units shall meet Industry Canada ICES-003 (Issue 4) Interference-Causing Equipment Standard for Digital Apparatus rule for Electromagnetic Interference.

5.1.4 The NITS units shall include an EIA-232 interface configurable for a transmission rate range of 2400 to 115200 bps.

5.1.5 The NITS units shall be housed in NEMA-4X enclosure suitable for outdoor, year-round installation and operation in the Ontario climate. The operating temperature shall be in the range of – 37^{o} C to + 74^{o} C and up to 95% relative humidity.

5.1.6 The units shall be supplied with a mounting mechanism consisting of a plated steel universal ball-joint secured to a bracket suitable for banding or bolting to a wood pole.

5.1.7 The NITS unit shall accept 12-24 VAC. The Contractor shall provide a 12-24 VAC power supply at the field cabinet 120 VAC power distribution assembly to generate power required for the operation of NITS unit.

5.1.8 The NITS units shall be capable of poll mode and be able to accept polling by the ATC at a 20 second rate after calibration is completed.

5.2 Cabling for Hardwired Applications

5.2.1 The cable between the NITS unit and the ATC shall meet the requirements of this Special Provision. Any deviation from the requirements herein shall be approved by the Contract Administrator.

5.2.2 The cable shall contain 12 conductors of datalene or S-R PVC insulated 22 AWG stranded tinned copper conductors. The jacket shall be constructed of PVC. Conductors shall be colour coded.

5.2.3 The shield shall consist of an overall aluminium-polyester shield and an overall tinned copper braid. A 22 AWG stranded tinned copper drain wire shall be provided.

5.2.4 The outer diameter shall not be greater than 12 mm and shall be suitable for attachment to the connectors.

5.2.5 The cable between the NITS unit and the ATC shall be continuous. No intermediate splices shall be allowed.

5.2.6 The cable shall be rated for an outdoor installation in an underground duct or aerial span of up to 15 m without external support.

5.2.7 Cable lengths between the NITS unit and the ATC shall be maximum 15 m unless otherwise recommended by the manufacturer. For longer distances between the NITS and cabinet, RF equipment shall be used.

5.3 Connectors

Cable connectors shall meet the requirements of CSA Standard C22.2 No. 65. Interface cables and connector pin-outs shall support data and power connections in accordance with manufacturer’s recommendations and equipment interface requirements. All connectors shall have a metallic shield and shall be capable of fastening to the mating device such that pulling on the cable or connector does not result in a loss of connection. The connector shall be male or female as required by the mating device and shall be supplied with solder-less, gold-plated pins or receptacles respectively which shall be capable of being relocated within the connector housing.

The serial connectors to the ATC communications port shall be DB-9.

The connector at the NITS unit shall be in accordance with the manufacturer specifications.

5.4 Surge Suppression

5.4.1 Transient surge suppression shall be provided for the power supply connection between NITS unit and the cabinet. The product shall be rated for a clamping voltage of 40 volts and be suitable for operation in temperatures of – 30^{o} C to + 50^{o} C.

5.4.2 Transient surge suppression shall be provided for the serial interface between the NITS unit and the cabinet. The product shall be rated for a clamping voltage of 15 volts and rated for operation in temperatures of – 30^{o} C to + 50^{o} C.

5.4.3 Surge suppression installation shall include a PVC junction box to be mounted on the NITS unit pole and associated #6 AWG bare ground wire and a ground electrode.

5.5 Wireless Communication for Non-Hardwired Applications

Where specified in the Contract, NITS units shall be supplied with RF communications equipment to enable communication between remote NITS and ATCs. The RF equipment shall meet the following requirements:

5.5.1 The digital spread spectrum equipment interface shall be compatible with the NITS unit.

5.5.2 The wireless communications system shall include radio equipment at the NITS unit and ATC cabinet, radio equipment enclosures, antennae and interconnect cables/conduits to enable communication between the remote NITS unit and ATC controller.

5.5.3 The wireless communications system shall employ digital spread spectrum technology. The wireless communications system shall operate within 900 MHz or 2.4 GHz spread spectrum bands. An appropriate frequency shall be chosen that does not require any radio frequency licensing or fees.

5.5.4 The RF cable type and length between the radio and antenna shall be per manufacturer recommendations.

5.5.5 The master units placed in field cabinets shall be able to communicate with at least 4 remote NITS units.

5.6 Solar Power Supply

Where specified in the Contract, the remote NITS units shall be supplied with a solar power supply assembly to provide continuous, year round operation of the NITS without external power supply.

5.6.1 The solar power supply system shall support continuous operation for the NITS unit and the digital spread spectrum RF equipment.

5.6.2 The solar power supply assembly shall provide not less than 16 days of battery autonomy to 80% of discharge (at – 10^{o} C).

5.6.3 The solar array and enclosure for the battery shall be suitable for pole mounting and shall be supplied with all required wiring, conduits, enclosures and mounting hardware.

5.6.4 All required cables between the battery, solar array and NITS unit shall be provided per manufacturer recommendation.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 NITS Units

7.1.1 The NITS units shall be securely mounted as shown in the Contract Drawings and in accordance with the manufacturer's installation guidelines. The NITS unit shall be mounted in such a manner as not to interfere with operation or any normal maintenance activities of the equipment already existing on the poles and/or structures.

7.1.2 The Contractor shall install the interconnect cable between the unit and the controller and the required connectors. The serial data wiring shall be terminated in a controller cabinet to allow interfacing to the ATC and power supply. The Contractor shall confirm the terminating equipment for all data interface equipment (e.g. DCE, DTE). All necessary cross connections shall be provided (e.g. Tx crossed to Rx) within the connector. Each cable shall be appropriately labelled at both ends as a "modem" or "null modem" cable according to the cross connections above. Data cable shall be connected to the port sharing device, port server or ATC, as shown in the Contract Drawings.

7.1.3 The NITS unit shall be grounded by connecting the cable drain wire to the cabinet ground.

7.1.4 Transient voltage surge suppression shall be installed for both data connection (EIA 232 interface) and power connection in a dedicated PVC box mounted on the NITS pole 1 meter below the NITS unit, in accordance with manufacturer recommendation. The surge suppression hardware shall be connected to external ground.

7.1.5 The Contractor shall conduct continuity testing of the new or existing cables and connectors to verify their proper operation prior to connecting the NITS units.

7.1.6 Cables shall be secured within the connector housing to prevent stress on the connections. Cables shall be installed neatly between adjoining equipment and shall be secured to rigid structures using appropriate fastening devices. Cable and connectors shall not be stressed during or after installation.

7.1.7 The NITS units shall be initially calibrated and tested to verify their operation in accordance with this specification. The NITS zone configuration shall be according to MTO lane/zone configuration files. This will be provided prior to installation. The NITS units shall be configured a zone number order where zone 1 = lane 1 (express lanes takes precedence over collectors). Any hardware and software required for calibration and testing of the units shall be included in this Contract item.

7.1.8 The Contractor shall verify that traffic data is being received at the Traffic Operations Centre prior to disconnecting of existing detection devices, as specified in the Contract.

7.1.9 The units shall be re-calibrated for each stage affecting lane configuration to provide accurate volume, speed and occupancy traffic data.

7.1.10 The Contractor shall maintain NITS units throughout the duration of construction. The Owner will notify the Contractor when units are not reporting data to central. The Contractor shall be required to address the problem within 24 hours (48 hours on weekends and holidays).

7.1.11 Unless otherwise noted in the Contract, the units and all associated components and cabling supplied under this item, shall be removed upon the reinstallation and acceptance of the loop detectors or other permanent detection devices, as indicated in the Contract, and returned the Owner.

7.2 Solar Power Supply

7.2.1 The solar power supply and battery enclosure shall be securely mounted on the pole with stainless steel banding.

7.2.2 The solar panels shall be oriented southerly and angled skyward for maximum exposure to sunlight as per manufacturer recommendations.

7.2.3 The solar panels and battery enclosure shall be mounted in such a manner as not to interfere with operation or any normal maintenance activities of the equipment already existing on the poles and/or structures.

7.2.4 Wiring for the solar power supply shall be installed in accordance with the manufacturer's specifications.

7.3 Radio

7.3.1 The radio equipment and antennae shall be installed at the NITS pole and cabinet locations identified in the Contract Drawings to form an operational RF link. The master radio shall be installed on a rack shelf inside the controller cabinet in such a location as to not interfere with other enclosed equipment.

7.3.2 The radios shall be connected to the yagi antennae with an appropriate conduit, RF cable and connector and configured to communicate with the NITS units identified in the Contract.

7.3.3 The master radio shall be connected to the port sharing device or ATC via a communications port with DB9 connector as shown in the Contract Drawings.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1		√	
5.1.2			√
5.1.8		√	√
7.1.2		√	
7.1.5		√	
7.1.7		√	
7.1.8			√
7.1.9		√	√

CLAUSE	PIT	POP	SIT
7.3.3		√	

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of NITS units is by planned quantity as may be revised by adjusted plan quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all the labour, Equipment and Materials required to do the work, except System Integration Testing which is paid for under a separate item.

WARRANT: Always with this item.

<u>CONTROLLER CABINETS, POLE MOUNTED</u> - Item No.

Special Provision No. 682S27 September 2007

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1. SCOPE

This Special Provision covers the requirements for the installation of pole mounted controller cabinets and associated internal components and mounting hardware.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Canadian Standards Association:

CSA C 22.2 No. 75 Thermoplastic Insulated Wires
CSA C 22.2 No. 65 Wire Connectors

Electronic Industries Alliance:

EIA-310-D Cabinets, Racks, Panels and Associated Equipment

National Electrical Manufacturers Association (NEMA):

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)-NEMA 3R

Others:

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

Pole Mounted Controller Cabinet: means an outdoor enclosure used for the housing of the controller unit, communications equipment and associated power supply components, permanently attached to a pole.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the cabinet components and shop drawings for cabinet design, external features and internal cabinet layout to the Contract Administrator for review prior to manufacturing.

5. MATERIALS

5.1 General

5.1.1 The cabinet shall satisfy minimum dimensions as shown in the Contract Drawings. The cabinet shall accommodate mounting of all intended cabinet equipment.

5.1.2 The cabinet shall be manufactured of aluminium 3 mm (1/8 inch) minimum thickness and shall be of grey non-reflective finish. Paint shall be gloss polyester powder paint, applied inside and out. All exterior seems shall be continuously welded. The construction shall be free of dents, scratches and abrasions.

5.1.3 The cabinet shall include pre-fabricated knockouts in the bottom surface to allow connection of up to 4-50 mm conduits.

5.1.4 The cabinet shall satisfy the NEMA 3R standard. The cabinet shall include adequate drainage facilities in the bottom surface to allow condensation from the interior walls to drain to the outside with appropriate measures to reduce insect/rodent infiltration.

5.1.5 The cabinet shall include two single doors with 180 degree motion and door latching mechanism at top and bottom. The key locking mechanism shall be provisioned with a key hole cover to prevent water ingress. Locks shall be keyed alike with 2 keys supplied for each cabinet. Door handles shall have provision for padlocking in closed position. Each door hinge shall be a single continuous hinge with fixed pin. The hinge and pin shall not be accessible from outside when door is closed. Doors shall be provided with self-engaging catches to hold the door open at both 90^o and 180^o.

5.1.6 Each cabinet shall be provided with louvered vents with removable air filters. The filters shall cover the vents and shall fit firmly against the vents. The filters shall be attached with brackets or clamps. The bottom vent shall allow water to drain to the outside. The filter frame shall be painted to prevent corrosion.

5.1.7 The cabinet shall include a 480 mm (19’’) EIA rack assembly with a minimum of 15U of rack space inside. The rack should be open frame allowing both front and rear access for maintenance. One rack shelf shall be provided in the top section of the cabinet. The rack shall provide two vertical cable management trays, one for the power cables and one for communications cables, installed on one side of the cabinet. The rack shall be grounded.

5.1.8 A trouble lamp with basket shall be mounted near the top of the rear door so it can be removed without the use of tools. The trouble lamp shall include an on/off switch and minimum 2 metre length of coiled wire.

5.1.9 The cabinet shall be supplied with non-corrosive pole mounting brackets.

5.2 Power Supply

5.2.1 The power supply must include the following: single pole, 120 VAC, 15 Amp main disconnect breaker, circuit breakers for environmental controls and service receptacles, solid ground bus, solid neutral bus, surge arrester, two duplex 120 VAC receptacles and all mounting provisions. All wiring size and colour coding shall conform to Ontario Electrical Safety Code.

5.2.2 The power supply shall be enclosed to prevent accidental contact with energized parts.

5.3 Environmental Controls

5.3.1 Each cabinet shall be equipped with an electric fan with ball or roller bearing and a capacity of 1.5 cubic metre of air per minute. The fan shall be easily replaceable without removing any components of the cabinet. The fan shall be covered with a protective mesh for safe operation.

5.3.2 Each cabinet shall be equipped with forced air heater rated at 400 Watts minimum. The heater assembly shall consist of a heater, a fan and mounting bracket. The heater shall be mounted within the cabinet such that it does not obstruct equipment and cabling within the cabinet.

5.3.3 The heater and fan shall be thermostatically controlled with a digital thermostat. Internal cabinet temperature must fall within a range of 0^{o}C to 55^{o}C year round.

5.3.4 The thermostat shall be of microprocessor design with digital entry and display for observing and setting the thermostat parameters. All recorded temperature values shall not be affected by a power failure.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 General

7.1.1 The cabinet shall be securely mounted on the pole as shown in the Contract Drawings.

7.1.2 The Contractor shall install all necessary conduits, fittings, interconnect wiring, grounding and bonding systems and any accessories required to provide a secure and compliant connection of supply service to the cabinet. All conduits shall be water sealed after installation of wiring.

7.1.3 The controller cabinet shall be energized immediately following installation and all environmental equipment shall be operational.

7.1.4 The Contractor shall install a laminated phenolic plastic nameplate on each installed cabinet. The nameplate shall be installed on the side of the cabinet facing the highway or so as to be easily seen when approaching along the highway. The nameplate shall be 450 mm x 70 mm with 50 mm high with white lettering, 8 mm letter stroke width and 6 mm spacing between letters, on a black background (Example: 401CE0420DEC). Letters shall be generated by an engraving machine. The nameplate shall be fastened with four stainless steel self tapping screws, with 'Robertson' No. 2 (red) heads. The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates. The nameplate shall contain the full 12 characters of the Universal Identifier including the highway name.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The Contractor is required to perform quality control testing on 10% of cabinets and 100% of digital thermostats prior to delivering the cabinets and thermostats. The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1	√		
5.1.2	√		
5.1.3	√		
5.1.4	√		
5.1.5	√		
5.1.6	√		
5.1.7	√		
5.1.8	√		
5.1.9	√		
5.2.1	√		
5.3.3	√		
5.3.4	√		
7.1.1		√	
7.1.4		√	

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of controller cabinets, pole mounted, is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of all drawings, text and test results.

WARRANT: Always with this item.

UNINTERRUPTIBLE POWER SUPPLY UNITS - Item No.

Special Provision No. 682S28 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of uninterruptible power supply units (UPS).

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Canadian Standards Association:

CSA C22.2 No. 107.1-01 General Use Power Supplies

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

American National Standards Institute (ANSI):

ANSI C62.41-1991 Guide on Surge Voltages in AC Power Circuits Rated up to 600V (formerly known as IEEE 587)

Other:

Canadian Electrical Code (CEC) Section 10 Grounding and Bonding

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the uninterruptible power supply units to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Functional Requirements

5.1.1 The UPS shall provide uninterruptible power and conditioning of the utility power required for operation of sensitive electronic equipment in the event of main utility power supply failure and voltage or frequency fluctuations.

5.1.2 The UPS unit shall be an “online” type with automatic voltage regulation, 120 VAC, 60 Hz, single phase.

5.1.3 The UPS shall include the wiring necessary to interconnect UPS unit to the power source.

5.1.4 The UPS unit shall be EIA 480 mm rack mountable or be supplied with rack shelf suited for the EIA RS-310-D standard.

5.1.5 The UPS unit shall include a communication port to support remote management and monitoring capabilities including alarm contacts, inverter contacts, and remote shutdown. This communication port shall be a USB port and/or RS-232 serial port. The remote monitoring software and shall be included.

5.2 Batteries

5.2.1 The UPS unit shall include self-contained, sealed, maintenance-free batteries with a minimum lifetime of 5 years.

5.2.2 The UPS unit shall have a minimum reserve time of 10 minutes at an ambient temperature of 25^{o} C with the typical load connected. Typical load shall be an ATC and all connected communications equipment or 50% of the rated VA capacity of the entire cabinet load, whichever is greater.

5.2.3 The UPS unit shall include automatic restart option. Upon restoration of utility AC power and complete battery discharge, the UPS shall automatically restart and assume function. The battery shall automatically recharge.

5.3 Environmental

The UPS unit shall be fully operational in external ambient temperatures ranging from 0^{o} C to $+40^{o}$ C and relative humidity of 10 to 95% non-condensing.

5.4 Electrical

5.4.1 The UPS unit shall provide voltage regulation at 120 VAC ±3% under any line, load or battery conditions and frequency regulation of ±5% synchronized to utility main.

5.4.2 The UPS unit shall accept AC input voltage range of 0 to 138 VAC, single phase, 2-wire plus ground.

5.4.3 The UPS unit shall have a minimum power rating of 1200 VA.

5.4.4 The UPS unit shall provide sine-wave, computer-grade power compatible with all computer loads, power factor corrected. It shall meet or exceed CSA C22.2 No. 107.1 for total harmonic distortion (THD).

5.4.5 The UPS unit shall include full-time protection from sudden voltage increase with inrush protection, battery back up, and AC line filtering.

5.4.6 The UPS unit shall have a minimum of four (4) CSA 5-15 R receptacles. Power bars supplied shall include integrated surge protection. Any receptacle splitters required to connect the equipment shall be provided.

5.4.7 The UPS unit shall provide complete isolation from the line operating as a separately derived power source under Canadian Electrical Code (CEC) Section 10.

5.4.8 The UPS unit shall provide an overload alarm and circuit breaker designed to operate at an overload of 200% surge.

5.4.9 Nominal voltage frequency shall be 60Hz and include tracking of output voltage frequency to input frequency within adjustable limits.

5.4.10 UPS shall meet safety compliance with CSA (C-UL), and CEC.

5.4.11 UPS shall meet EMC compliance with Standards Council of Canada (SCC).

5.4.12 UPS shall be tested and approved to ANSI C62.41-1991.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation

7.1.1 The UPS units shall be installed typically immediately above or adjacent to power distribution assembly. In 401 cabinets type D and R the UPS units shall be installed in top section of the cabinet.

7.1.2 The Contractor shall install the uninterruptible power supplies as per the manufacturer recommended installation procedure.

7.1.3 For UPS units installed in controller cabinets, the Contractor shall connect the input side of the UPS to the cabinet power distribution assembly supply power via one of the receptacles.

7.1.4 For UPS units installed in the head-end facilities, the Contractor shall connect the input side of the UPS to the rack power distribution assembly power via one of the receptacles.

7.1.5 The Contractor shall connect the communications equipment components to the UPS output receptacles.

7.1.6 The Contractor shall activate the UPS unit in accordance with the manufacturer's recommendations. The Contract Administrator will advise the Contractor if the serial communications port and remote monitoring is to be activated. The Contractor shall deliver the remote monitoring software and documentation as part of the system documentation.

7.1.7 The Contractor shall neatly train and organize all cables.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.5	√		
5.2.2	√	√	
5.2.3	√	√	
5.4.1	√		

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of uninterruptible power supplies is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work.

WARRANT: Always with this item.

MAGNETIC DETECTORS - Item No.

Special Provision No. 682S29 July 2009

1. SCOPE

This Special Provision covers the requirements for the installation and testing of magnetic detectors. Each magnetic detector item shall include the following:

a) Magnetic sensors
b) Sensor carriers
c) Lead-in cables
d) Splice kits

2. REFERENCES – Not Used

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

Magnetic detector: means magneto-inductive detector capable of sensing fluctuations in a varying incident magnetic flux density and converting such fluctuations into a corresponding variable inductance at its electrical port.

Sensor: means an assembly of magneto-inductive probes installed in a carrier in an under pavement conduit that, together with a lead-in cable and a vehicle detector sensor unit, are able to detect vehicles in a single traffic lane.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for all components of the magnetic detectors to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 General

5.1.1 Magnetic sensors, lead-in cables and sensor carriers when operating together with detector cards and controllers shall form an operational system which provides monitoring of traffic conditions on the roadway where it is installed. At minimum, it shall provide volume, occupancy and speed data with accuracy of +/- 5% or better for all types of vehicles

5.1.2 The nominal inductance of magnetic detectors shall be 60 microhenries per probe plus 16.5 microhenries per 30m of lead-in cable, and the inductance value measured using a suitably calibrated meter shall be within ± 20% of the calculated value.

5.1.3 The measured change to the nominal inductance of a magnetic detector, when a midsize vehicle passes over the installed detector, shall lie within the range of 120 nanohenries to 1200 nanohenries.

5.1.4 The nominal DC resistance of magnetic detectors shall be 1.5 Ohms per probe plus 3 Ohms per 30m of lead-in cable, and the DC resistance measured using a suitably calibrated meter shall be within ± 20% of the calculated value.

5.2 Magnetic Sensors

5.2.1 Magnetic sensors shall be 2-probe units as specified elsewhere in the Contract Documents.

5.2.2 Each sensor shall render an inductance change in the presence of vehicles containing ferromagnetic material. Sensors shall detect these vehicles when they are within a travel distance less than one half (½) the height of the ferromagnetic material of the vehicle.

5.2.3 Sensors shall function within geographic zones where the nominal magnitude of the vertical geomagnetic field lies within the range of 200 millioersteds to 800 millioersteds, and over temperatures ranging from – 34^{o} C to + 74^{o} C.

5.2.4 The nominal operating frequency of the probes shall be between 20 kHz and 60 kHz.

5.2.5 The probes shall operate with drive currents of between 14 milliamp and 80 milliamp peak to peak.

5.2.6 The probes shall have an outer diameter of 20.64 mm, a height of 57.2 mm and shall snap easily into their associated carriers.

5.3 Lead-in Cables

5.3.1 The magnetic detector lead-in cable shall consist of two AWG 22 polyvinyl chloride insulated conductors within a polyurethane jacket. The overall diameter of the cable shall not exceed 5mm.

5.3.1 Required lead-in cables lengths for magnetic sensors shall be determined by the Contractor prior to ordering based on the Contract Documents. Lead-in cables shall be of suitable length to reach the roadside splice points to the extra-low voltage (home-run) cables.

5.4 Sensor Carriers

5.4.1 The carrier mechanism for the probes shall allow the placement, holding and inserting of double or triple probe magnetic sensors in duct.

5.4.2 Carriers shall allow probes to be placed at spacing increments reflecting duct installation results and/or specific site conditions.

5.4.3 Carriers and magnetic sensor components shall be readily assembled on-site without special tools.

5.4.4 The first carrier within the chain (end cap carrier) shall have a rope attached with sufficient strength to assist in the removal of the carriers from the conduit.

5.4.5 Carriers shall hold up to twelve (12) lead-in cables in addition to the required pull rope for sensor placement.

5.4.6 Carriers and their interlinking mechanism shall have sufficient strength to allow insertion of probes and auxiliary components into a duct of up to 35m length meeting the installation requirements.

5.4.7 The carrier system shall have a locking mechanism to maintain the orientation of all magnetic sensors within $\pm 20^{o}$ of vertical.

5.4.8 Carriers shall be suitably sealed for use in a 100% humidity environment in the conduit, including submersion in solutions of chemicals typical of roadway runoff.

5.5 Splice Kits

5.5.1 Splice kits shall be waterproof, underground rated, utilize compression connectors insulated with electrical insulating tape and shall be protected by a sealed body filled with insulating resin.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation

7.1.1 Installation of all sensors, lead-in cables & carriers shall be performed either by the manufacturer, or a Contractor specifically certified by the manufacturer for the installation of the magnetic detectors and associated assemblies in question. At all times, the Contractor shall follow the manufacturer’s recommendations during installation.

7.1.2 The Contractor shall obtain a log of duct depth for the underground ducts installed for magnetic sensors from either the duct installer or Contract Administrator, should the ducts have been installed outside of this Contract.

7.1.3 With the knowledge of the duct depth profile along the cross section of the roadway, the Contractor shall mount the magnetic probes and carriers under each of the lanes to be detected, in accordance with all manufacturer recommendations and specifications.

7.1.4 Carriers shall be installed in the ducts and aligned with the traffic lanes in accordance with the manufacturer installation guidelines.

7.1.5 The Contractor shall pay close attention to required adjustments in probe set spacing based upon the variable duct depth under each lane.

7.2 Splicing

7.2.1 Splicing of magnetic lead-in cable to extra-low voltage (home-run) cable shall be performed only at the designated splice points, as indicated in the Contract Documents.

7.2.2 Splicing of extra low voltage cables installed underground shall be made with compression connectors insulated with electrical insulating tape and protected with waterproof splices. Waterproof splices shall be installed according to the manufacturer's recommendations.

7.2.3 Splicing shall be performed in presence of the Contract Administrator.

7.3 Identification of Cables

7.3.1 The Contractor shall identify each magnetic sensor with a permanent vinyl sleeve wire marker at the splice point and at the controller cabinet terminal. Each magnetic sensor shall be labelled as shown on the layout drawings (ie. No. 1, No. 2, No. 3 – etc)

7.3.2 Each magnetic sensor detector station shall be identified by installing a nameplate on the inside wall of the splice point where the magnetic sensor lead-in wires enter the splice point and inside the controller cabinet. The nameplate shall be visible from above when the splice point cover is removed. Nameplates shall be fastened to the electrical chamber wall using concrete anchors and shall be laminated phenolic plastic, black with white core. Lettering shall be 13 mm high and shall identify the full loop station identifier as indicated on the drawings.

7.3.3 The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.2	√[1]	√[2]	
5.1.3		√[2]	
5.1.4	√[1]	√[2]	

<u>Testing Footnotes</u>

[1] Electrical pre-installation testing for magnetic sensors shall be performed prior to installation in under-roadway conduit.

[2] Electrical proof of performance testing for magnetic sensors shall be performed for each installed sensor assembly at the roadside chamber, before splicing of the extra-low voltage (home-run) cables.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of magnetic detectors is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment and Materials required to do the Work, except for SIT which is paid for under a separate item.

WARRANT: Always with this item.

CONCRETE POLES, DIRECT BURIED IN EARTH WITH CAMERA RAISING AND LOWERING SYSTEM – Item No.
CONCRETE POLES, DIRECT BURIED IN ROCK WITH CAMERA RAISING AND LOWERING SYSTEM – Item No.

Special Provision No. 682S30 July 2009

Amendment to OPSS 615, November 2008

615.01 SCOPE

Section 615.01 of OPSS 615 is amended by the addition of the following:

This Special Provision covers the requirements for the erection, integration and testing of centrifugally cast, prestressed concrete poles complete with Camera Raising and Lowering System used for attachment and lowering of dome Closed Circuit Television Cameras (CCTV).

615.02 REFERENCES

Section 615.02 of OPSS 615 is amended by the addition of the following:

American Society of Civil Engineers (ASCE):

ASCE 7 Minimum Design Loads for Buildings and Other Structures

American Society for Testing and Materials (ASTM):

ASTM-C150	Standard Specification for Portland Cement
ASTM-C494	Standard Specification for Chemical Admixtures for Concrete
ASTM-A615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM-A416	Standard Specification for Steel Strand, Uncoated Seven-Wire for Prestressed Concrete
ASTM-A36	Standard Specification for Carbon Structural Steel
ASTM-B240	Standard Specification for Zinc and Zinc-Aluminium (ZA) Alloys in Ingot Form for Foundry and Die Castings
ASTM-A153	Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

International Organisation for Standardization (ISO):

ISO 9001 Quality Management Standard

615.04 DESIGN AND SUBMISSION REQUIREMENTS

Section 615.04 of OPSS 615 is amended by the addition of the following subsections:

615.04.01 Design Requirements

615.04.01.01 Poles

Poles shall be designed to accommodate and interface with the camera lowering system and related equipment. The pole and the raising and lowering system shall be considered an integral system.

Poles shall be designed considering application of wind load and dead load.

Poles shall be designed to withstand a 3-second gust of 145 to 241 kilometers per hour, as the American Society of Civil Engineers (ASCE) requires in the ASCE 7 standard.

All poles up to 21.3 m (70 ft) shall be designed to have a maximum deflection not greater than 25 mm. All poles of 24.4 m (80 ft) shall be designed for maximum deflection not greater than 30 mm.

If a colour other than grey is proposed, all pigments used shall be non-fade iron or chromium oxides. Color other than grey must be approved by the Contract Administrator. All poles to be etched and finished with two coats of waterproof breathing membrane of methyl methacrylate. Any deviation from this aggregate finish, colour, and composition requires approval from the Contract Administrator.

615.04.01.02 Camera Lowering System

The camera-lowering system shall be designed to withstand wind forces of 160 kilometres per hour with a 30 percent gust factor using a 1.65 safety factor.

The lowering system manufacturer, upon request, shall furnish independent laboratory testing documents certifying adherence to the stated wind force criteria utilizing, as a minimum effective projected area, the actual EPA or an EPA greater than that of the camera system to be attached.

615.04.02 Submission Requirements

The Contractor shall submit to the Contract Administrator shop drawings for the concrete pole for review prior to ordering.

The Contractor shall submit to the Contract Administrator product references and shop drawing for the raising and lowering system for review prior to ordering.

The camera-lowering system shall be the product of manufacturers with a minimum of 3 years of experience in the successful manufacturing of camera lowering systems. The lowering device provider shall be able to identify a minimum of 3 previous projects, along with references for each, where the proposed system has been installed successfully.

The manufacturer shall provide the documentation certifying that the electrical Contractor performing installation of the camera raising and lowering system has been instructed on the installation, operation and safety features of the system.

615.05 MATERIALS

615.05.01 Concrete

Subsection 615.05.01 of OPSS 615 is deleted and replaced with the following:

Concrete shall conform to OPSS 1350 for 55 MPa class.

The pole shall achieve a minimum 28-day compressive strength of 55 MPa. Cement shall conform to the latest requirements of Type I Portland Cement in accordance with ASTM-C150. Maximum size aggregate may be ¾ inch (19 mm) or ¾ of the clear spacing between reinforcing steel and surface of pole. Any water reducers, retarders, or accelerating admixtures shall conform to ASTM-C494. Water shall be free from foreign materials in amounts harmful to concrete and embedded steel.

Poles shall be prestressed and the concrete placed by the centrifugal spinning process. The centrifugal spinning is to insure both a minimum 28-day compressive strength of 55 Mpa and a minimum of 19mm cover over the prestressing strand.

A concrete cylinder test shall be performed for each 75 m^3 of concrete poured. A final quality control check shall be carried out on each pole after manufacturing is complete. All quality control procedures shall be mandated in a written manual and be available for inspection.

The manufacturer shall have a minimum of 10 years of experience in the design and production of centrifugally spun concrete poles.

615.05.02 Steel Reinforcement

Subsection 615.05.02 of OPSS 615 is amended by the addition of the following clauses:

615.05.02.01 Reinforcing Steel

Deformed steel reinforcement shall conform to requirements of ASTM-A615 for Grade 60 Rebar.

615.05.02.02 Spiral Reinforcement

Steel spiral reinforcement shall conform to the requirements of ASTM-A82 and shall not be less than 3.8 mm diameter.

615.05.02.03 Prestressing Steel

Prestressing steel reinforcement shall conform to uncoated 7-wire, stress-relieved strand; ASTM-A416.

615.05.02.04 Hardware

All structural steel shall conform to ASTM-A36 and zinc alloy AC41A shall conform to ASTM-B240. The finish shall be hot dipped galvanized in accordance with ASTM-A153.

615.05.03 Poles

Subsection 615.05.03 is amended by addition of the following:

Poles shall have a smooth natural form finish, soft grey in colour.

Poles shall be designed and constructed so that all wiring and grounding facilities are concealed within the pole. All handholes, couplings, thru-bolt holes and ground wire shall be cast into the pole during the manufacturing process.

Poles shall be round in cross section and provide a continuous taper of 15 mm per meter of length and provide a minimum 19 mm of concrete coverage over the prestressing strands.

All cable entry holes shall be in accordance with the location on submittal drawings, and sizes as required, and shall be free from sharp edges for passages of electrical wiring. As a minimum the following openings will be provided:

a) Two 76 mm x 305 mm conduit entrance openings centered 457 mm below grade;
b) Two 114 mm x 305 mm steel galvanized reinforced handhole frames with flush cover located above grade.

Poles shall be provided with a fish wire to facilitate cable installation.

All poles to have a minimum inside raceway dimension of 76 mm at tip of pole.

All manufacturing tolerance, details of reinforcement, and finishes shall be in accordance with the Guide Specification for Prestressed Concrete Poles as published in the May-June, 1982, issue of the Journal of the Prestressed Concrete Institute.

Section 615.05 is amended by addition of the following subsections:

615.05.06 Electrical Ground

All poles will be supplied with a #6 stranded copper ground wire cast into the wall of the pole at the handhole box location.

615.05.07 Concrete Pole Fill

Concrete pole fill shall have a minimum compressive strength of 3.5 MPa**.**

615.05.08 Lowering System

615.05.08.01 Functional Requirements

The camera lowering system shall mount to a purpose-designed tenon bolted to the top of the pole.

The camera lowering system shall be designed to support and lower a dome type camera, cabling, connectors and other supporting field components without damage or causing degradation of camera operations.

The lowering system shall consist of a suspension contact unit, divided support arm, and a pole adapter for attachment to a pole-top tenon, pole-top junction box, and camera connection box.

The divided support arm and receiver brackets shall be designed to self-align the contact unit with the pole center line during installation and insure the contact unit cannot twist under high wind conditions.

The suspension contact unit shall have a load capacity 91 kg 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 minimum of 2 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 Contractor shall supply internal conduits in the pole for the power, communications, and video cabling.

The only cable permitted to move within the pole or lowering system during lowering or raising shall be the lowering cable. All other cables must remain stable and secure during lowering and raising operations.

The camera-lowering system shall be operated by use of a portable lowering tool. 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. The tool shall be designed to operate with either a hand crank supplied with the tool or a variable speed industrial duty electric drill. This tool shall be compatible with, and seat properly on supplied pole and provide easy access to the support cable through the handhole of the pole.

The lowering tool shall attach to the pole with one single bolt. The bolt receptor shall accommodate a 19 mm (¾ inch) stainless steel bolt. The tool shall support itself and the load assuring lowering operations and provide a means to prevent freewheeling when loaded. The lowering tool shall be delivered to the designated ATMS Maintenance representative upon project completion. Two stainless steel through bolts and wing nuts shall be supplied with this item.

The lowering tool shall have a reduction gear to reduce the manual effort required to operate the lifting handle to raise and lower a capacity load.

The lowering tool shall be provided with an adapter for operating the lowering device by a portable drill using a clutch mechanism.

The lowering tool shall be equipped with a positive breaking mechanism to secure the cable reel during raising and lowering operations and prevent freewheeling.

The manufacturer shall provide a variable speed, heavy-duty reversible drill motor and a minimum of one lowering tool.

The manufacturer shall provide weights and / or counterweights as necessary to allow easy alignment of the guide pin and connectors when camera is being raised into position.

The lowering unit will have sufficient weight to disengage the camera and its control components in order that it can be lowered properly.

The manufacturer shall provide a mounting flange sufficient for mounting their respective camera assembly to the bottom of the camera connection box.

All electrical and video coaxial connections between the fixed and lowerable portion of the contact block shall be protected from exposure to the weather by a waterproof seal to prevent degradation of the electrical contacts.

615.05.08.02 Physical

The 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.

All pulleys for the camera lowering device and portable lowering tool shall have sealed, self lubricated bearings, oil tight bronze bearings, or sintered bronze bushings.

The lowering cable shall be a minimum 3 mm (1/8 inch) diameter stainless steel aircraft cable with a minimum breaking strength of 790 kg (1740 pounds) with seven (7) strands of # 19AWG wire each.

The interface and locking components shall be made of stainless steel and or aluminium.

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.

615.05.08.03 Electrical

The female and male socket contact halves of the connector block shall be made of thermosetting synthetic rubber known as Hypalon or approved equivalent. The female brass socket contacts and the male high conductivity brass or gold plated pin contacts shall be securely attached to the connector block body.

The current carrying male contacts shall be 2.8 +/- 0.2 mm in diameter. There shall be two male contacts that are longer than the rest which will make first and break last providing optimum grounding performance.

The number of contacts shall be 14 and the camera mounted thereto, shall be capable of performing all of its necessary functions on 14 contacts or less.

The current carrying female contacts shall be 2.8 +/- 0.2 mm in diameter. All of the contacts shall be recessed or chamfered from the face of the connector block. The design of the connector block shall create a watertight seal when the two halved are mated.

The wire leads from both the male and female contacts shall be securely attached in the connector body. The current carrying and signal wires shall be constructed of #18/1 AWG jacketed wire.

The contacts shall be self-wiping with a shoulder at the base of each male contact so that it will recess into the female block, thereby giving a rain-tight seal when mated. The manufacturer of the electrical contact connector must be ISO 9001 certified. The connector must be identified by the manufacturer for outdoor use.

The electrical connections between the fixed and movable lowering device components shall be designed to conduct high frequency data bits and one (1) volt peak-to-peak video signals as well as the power requirements for operation of dome environmental controls.

The manufacturer shall provide the power and signal connectors for attachment to the bare leads in the pole top and camera junction boxes. These connectors shall come with 3 foot lead wires.

The camera raising and lowering system shall be CSA approved.

615.07 CONSTRUCTION

Subsection 615.07.03 of OPSS 615 is amended by the addition of the following clauses:

615.07.03.04 Pole Filling

The hollow core of the pole shall be filled with concrete up to the lower wiring aperture level.

615.07.03.04 Duct Entry

The Contractor shall trim the pole wiring aperture to allow duct entry and mortar the duct in place.

615.07.03.05 Handling and Erection

The camera raising and lowering system shall be integrated with the concrete pole and the dome camera supplied under this Contract and installed as shown in the Contract Drawings.

The installation shall follow the manufacturer's guidelines for the three components and applicable Contract requirements.

Pre-stressed concrete poles shall be lifted and supported during manufacturing, stockpiling, transporting and erection operations only at the points shown on the shop drawings.

Transportation, site handling, and erection shall be performed using only manufacturer recommended equipment and methods, and by qualified personnel.

In order to mitigate the effects of poor soil quality condition, the Contractor shall utilize a steel liner to support walls of the augured hole.

The lowering device manufacturer shall furnish a factory representative to assist the electrical Contractor with the assembly and testing of the first lowering system onto the pole assembly. The Contractor shall be responsible for providing "on site" operational instructions to Owner's maintenance personnel.

615.07.07 Quality Control

615.07.07.01 Pre-Installation Testing and Inspection

Section 615.07.07.01 of OPSS 615 is amended by deleting of the last paragraph.

615.07.07.02 Proof of Performance Testing and Inspection

Clause 615.07.07.02 of OPSS 615 is amended by addition of the following:

For each installed concrete pole complete with raising and lowering system, the Contractor shall fully raise and lower the assembly a minimum of 5 times, which shall constitute a complete performance test. Each time the assembly is fully raised and lowered, the assembly shall be raised from the bottom of the pole (top of the handhole) to the top of the pole, latched, then unlatched, and then lowered to the bottom of the pole. After each raising and lowering sequence, the Contractor shall inspect the raising/lowering equipment to ensure that components are not damaged and are working properly. The Contractor shall inspect the cables inside the pole and check for any twisted cables. Any twisted cables shall be untwisted before the next raising and lowering sequence commences. After each raising and lowering sequence, the Contractor shall also verify that the video signal from the camera is being received at the cabinet (or at TOC) and camera control functions properly.

If any problems or deficiencies occur during the testing, the Contractor shall cease the performance test and correct the problem or deficiency. Once the problem or deficiency has been corrected, the testing on that pole and associated material shall be repeated in its entirety by the Contractor, i.e. the Contractor shall again fully raise and lower the assembly a minimum of 5 times. The Contractor shall repeat this process until the Contractor is able to fully raise and lower the assembly a minimum of 5 times without any problems or deficiencies occurring during the testing.

The testing and inspection shall be witnessed by the Contract Administrator and the Owner maintenance representative. The Owner representative shall verify that the poles have been inspected, and that the material and installation comply with the requirements of the Contract.

615.09 MEASUREMENT OF PAYMENT

615.09.01 Actual Measurements

Subsection 615.09.01 of OPSS 615 is amended by the addition of the following clause:

615.09.01.15 Concrete Poles, Direct Buried in Earth with Camera Raising and Lowering System

For measurement purposes, a count shall be made of the number of concrete poles, direct buried in earth with camera raising and lowering system installed.

615. 09.01.16 Concrete Poles, Direct Burried in Rock with Camera Raising and Lowering System

For measurement purposes, a count shall be made of the number of concrete poles, direct buried in rock with camera raising and lowering system installed.

615.10 BASIS OF PAYEMENT

Section 615.10 of OPSS 615 is amended by the addition of the following subsection:

615.10.05 Concrete Poles, Direct Buried in Earth with Camera Raising and Lowering System – Item

Concrete Poles, Direct Buried in Rock with Camera Raising and Lowering System - Item

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work of installing concrete poles direct buried in earth with camera raising and lowering system installed.

WARRANT: Always with this item.

<u>MAGNETIC DETECTOR CARDS</u> - Item No.

Special Provision No. 682S31	February 2009

1. SCOPE

This Special Provision covers the requirements for the installation and testing of magnetic detector cards, which have been specifically designed to function with magnetic detectors, specified under a separate item, as well as associated software required for serial based configuration and real-time monitoring functionality.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 622 Installation of Traffic Signal Controllers

Ministry of Transportation Publications:

Ontario Traffic Signal Control Equipment Specifications (OTSCES)

National Electrical Manufacturers Association:

NEMA TS2 Traffic Controller Assemblies with NTCIP Requirements

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange. Commonly referred to as RS-232.

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

Magnetic detector: means magneto-inductive detector capable of sensing fluctuations in a varying incident magnetic flux density and converting such fluctuations into a corresponding variable inductance at its electrical port.

Sensor: means assembly of magneto-inductive probes installed in a carrier in an under pavement conduit that, together with home run cable and a vehicle detector card, are able to detect vehicles in a single traffic lane.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

4.1.1 The Contractor shall supply the specification sheets for the loop vehicle detector cards to the Contract Administrator prior to ordering.

4.1.2 Pursuant to the installation and configuration of the cards, the Contractor shall submit computer generated graphical plots indicating successful calibration and configuration of the cards and associated magnetic sensors to the Contract Administrator. One 8.5 x 11” sized plot for each lane that the card monitors shall be provided, and each plot shall contain superimposed waveforms from all magnetic sensors in the lane, with each waveform plotted in a unique colour. The waveform shall represent change in channel inductance/frequency (or a normalized value thereof) versus time. The scale shall be of sufficient length to include three complete vehicle detections for all magnetic sensors in the lane.

4.1.3 The Contractor shall provide a log of the nominal inductance measurement for each channel on each card following installation.

5. MATERIALS

5.1 Magnetic Detector Cards

5.1.1 General

5.1.1.1 Cards shall meet the requirements of applicable Ontario Traffic Signal Control Equipment Specifications (OTSCES) and all applicable addenda.

5.1.1.2 Cards shall meet NEMA TS2 requirements for Type 2 controller and cabinet assemblies, shall be configured as plug-in devices and shall meet TS2 Section 3.2 requirements for actuated Type 2 A2 operation.

5.1.1.3 Cards shall be operable with both 12 and 24 VDC power supplies.

5.1.1.4 Cards shall be equipped with standard 44 contact edge connectors and pinouts as per NEMA TS2 but meet compatibility requirements for installation in 22-lettered pin input files.

5.1.1.5. Four channels (magnetic sensor connections) shall be supported per card.

5.1.1.6 Cards shall be compatible with single, double and triple magnetic probe sets, as specified in the Contract.

5.1.1.7 In conjunction with the magnetic probe sets and home-run cables specified in the Contract, the cards shall be capable of detecting and holding the presence of all licensed motor vehicles within their probes’ radius of detection, including small motorcycles, while incorporating mechanisms to exclude vehicles in adjacent lanes.

5.1.1.8 To increase the accuracy of the vehicle count, cards shall support adjustable bridge time, which corresponds to the minimum typical gap between vehicles in fractions of a second. The bridge time shall be adjustable through cards’ configuration software.

5.1.1.9 The detection performance for the cards shall be maintained with home-run cable lengths up to 762m.

5.1.1.10 Cards shall include sensitivity adjustments for the cards’ detection threshold on a channel by channel basis and in a minimum of 8 incremental 2:1 steps, configurable both from the cards’ front panel and electronically through the configuration software.

5.1.1.11 Cards shall have a single, switched oscillator system to sequentially excite and measure each channel to prevent crosstalk between channels within a unit.

5.1.1.12 Cards shall support the adjustment of their oscillation frequency on a channel by channel basis to reduce the possibility of crosstalk between detector units. Frequency adjustments shall be configurable both from the cards' front panel and electronically through the configuration software.

5.1.1.13 Cards shall have a Presence or Pulse mode output option, configurable both from the cards' front panel and electronically through the configuration software.

5.1.1.14 Each card channel shall have measurement capability to continuously verify magnetic sensor system integrity. The cards shall be capable of detecting faults including short circuits to ground, open circuits or inductance changes of greater than 25% on any of their channels.

5.1.1.15 Vehicle detections and faults shall be visibly relayed through front panel LEDs.

5.1.1.16 Cards shall be capable of collecting and storing counts and occupancy in time bins for each channel, which shall later be available for retrieval using the configuration software over the cards' serial connectivity. The cards shall be provided with sufficient memory to store vehicle count and occupancy data in for all 4 channels on the card, in 15 minute time bins for a minimum of 36 hours.

5.1.2 Serial Communication

5.1.2.1 Cards shall support RS-232 serial communication to an external device for remote configuration and real-time monitoring functionality. Irrespective of any rear edge connector pin based serial connectivity, the cards shall provide a front panel DB-9, RJ-45 or Mini-DIN connector based serial interface.

5.1.2.2 Serial baud rates shall be selectable at 1200, 2400, 4800, 9600, or 19200 bps using the configuration software. Default factory settings for the serial link shall be indicated directly on the units or available from the manufacturer's documentation.

5.1.2.3 Communications cables with suitable mating connectors shall be provided with the cards for remote serial connection to an external configuration device (notebook computer typical).

5.2 Configuration and Data Acquisition Software

5.2.1 Cards shall be microprocessor controlled and shall be configurable via both manual switch settings and software settings held in on-board memory.

5.2.2 Microsoft Windows® XP software, along with all necessary media for reinstallation, shall be provided with the cards to: configure detector parameters including sensitivity and frequency; map card channels to magnetic sensors; setup communications settings; monitor hardware faults; setup on-board data recording; retrieve local data files; and to view realtime detection values.

5.2.3 The configuration software shall support optional password protection for any change of settings.

5.2.4 Additional Microsoft Windows® XP software, along with all necessary media for reinstallation, shall also be provided which allows for the capture of detector data from all four channels simultaneously over the card's serial connectivity. This software shall provide the ability to plot acquired data (actual or normalized change in inductance/frequency versus time) from any or all of the card channels on a single graph.

5.2.5 All configuration and data acquisition software shall be provided with the required licenses, documentation and training for independent Owner operation going forward.

5.2.6 Full disclosure of all serial protocols, message types and/or software parameters for the cards' configuration & data acquisition functionalities shall be granted to the Owner, so that the Owner may opt to develop fully functional card central management software for the Owner's exclusive use.

5.3 Acceptance of Alternative Product

5.3.1 For any proposed product which does not appear on the Designated Sources of Materials (DSM) listing for this contract item, the Contractor shall submit a Change Proposal for an alternative product according to the requirements of the MTO General Conditions of Contract for Change Proposals, under the category of "Alternative Types of Materials or Material Sources" subject to the following additional requirements.

5.3.2 Alternative magnetic detector cards shall be subject to a successful evaluation period of minimum 4 months duration, during which the Contractor shall demonstrate to the Owner that the alternative product meets all requirements of this specification. The Contractor shall provide and install three alternative magnetic detector cards into controller cabinet 400CN0065DSR (existing magnetic detector test site at Hwy 400 SB at Finch Avenue) for the purposes of this evaluation. Two-probe, Owner supplied magnetic detectors (6-lane detector station 400DN0059DSS) shall be used to evaluate the alternative cards. The Contractor shall provide 48 hours advance notice to the Contract Administrator prior to commencement of this work.

5.3.3 The Contractor shall obtain, from the Owner, 6-lane detection data for a detector station employing IDRIS® technology adjacent to 400DN0059DSS, and shall compute the difference in counts between the 400DN0059DSS station and the IDRIS® station on a per lane basis, for each of the following periods to be selected by the Contractor:

(i) a single 1-hour period of midday freeflow traffic for each month of the evaluation period.
(ii) a single 1-hour period of nighttime lightflow traffic for each month of the evaluation period
(iii) a single 2-hour AM peak period for each month of the evaluation period

5.3.4 The Contractor shall then be provided with 6-lane detection data from the Owner for another adjacent detector station which utilizes DSM listed magnetic detector cards for the periods selected, and shall compute the corresponding difference in counts between this station and the IDRIS® station.

5.3.5 At all times the Contractor shall ensure that the data from the three detector stations utilized in the comparison is synchronized with respect to its timebase and the Contract Administrator shall verify and certify all data and calculations.

5.3.6 The alternative magnetic detector card evaluation shall be deemed successful only if the count difference between the 400DN0059DSS station and the IDRIS® station is smaller or equal in magnitude to the count difference between the DSM listed magnetic detector count and the IDRIS® station, for each of the 6 lanes and each of the periods listed above in 5.3.3.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation

7.1.1 Installation, configuration & testing of the cards shall be performed according to the manufacturer's recommendations.

7.1.2 The Contractor shall install the cards in accordance with the requirements of OPSS 622 and as indicated in the contract drawings. Four channel detector cards shall be inserted into even numbered cabinet I & J input file slots only.

7.1.3 The Contractor shall ensure that the racks are not powered up while the detector cards are being installed.

7.2 Configuration

7.2.1 Upon connection of the magnetic sensor home-run cables to the input files in-cabinet, the Contractor shall install the configuration software on a notebook computer and utilize the serial connectivity of the cards for electronic calibration.

7.2.2 For sensor cards which monitor two magnetic detectors in a lead-lag configuration within the same lane, the Contractor shall map the lead-lag loop configuration to the actual channels on the sensor card using the software, taking into consideration the Owner's standard input file connection highlighted in the Contract Drawings. The Contractor shall also input the exact physical distance between lead-lag sensors as part of this mapping.

7.2.3 The Contractor shall set any applicable noise immunity parameters available on the cards.

7.2.4 The Contractor shall set all cards to Presence mode.

7.2.5 To restrict unauthorized access, the Contractor shall set a Contract Administrator provided password for future electronic reconfiguration of the cards.

7.2.6 The Contractor shall set the adjustable Bridge Time setting of the cards to 0.4 seconds, unless non-standard detector duct depths or other installation practices have been employed for the associated detector station, in which case the Contractor shall set an alternative Bridge Time which optimizes detector performance in accordance with the manufacturer's recommendations.

7.2.7 Utilizing the real-time activity monitoring features of the software, the Contractor shall determine the change in inductance for each channel in the presence of a standard car, and shall program the sensitivity value for each channel to a setting between 6.25% and 12.5% of this value.

7.2.8 The Contractor shall configure dissimilar oscillation reference frequencies for each card installed in the cabinet input files. In general, the cards monitoring the channels with the highest inductance (typically connected to the longest home-run cables) shall be assigned the lowest frequencies, and a minimum frequency offset of 3 KHz (10 KHz optimal) shall be established between each of the cards.

7.3 Testing

7.3.1 Utilizing the real-time activity monitoring features of the software, the Contractor shall confirm for each channel that the nominal channel inductance shall be within ± 20% of the following summation: magnetic detector inductance; lead-in cable inductance and home-run cable inductance.

7.3.2 The Contractor shall confirm for each channel that the change in nominal channel inductance shall be between 120 and 1200 nanohenries when a standard car passes over the corresponding magnetic detector.

7.3.3 Utilizing the data acquisition and plotting functions of the card software, the Contractor shall examine the waveform for each card channel and verify that the amplitude of the peak to peak noise present on each channel shall be no greater than one half the amplitude of the sensitivity value set by the Contractor.

7.3.4 Utilizing the data acquisition and plotting functions of the card software, the Contractor shall verify that the lead and lag loops in each lane produce waveforms which are approximately equal in both shape and amplitude, albeit shifted slightly in time, when the same vehicle drives over both loops sequentially. These waveforms shall then be submitted to the Contract Administrator for approval as specified in Section 4.

7.3.5 Utilizing the collection and storage functionality of the cards, the Contractor shall extract 15 minutes of binned traffic counts for each card channel. The Contractor shall then confirm that the counts recorded for sensors in the same lane are approximately equal, notwithstanding small discrepancies which may be attributed to lane changes.

7.3.6 The Contractor shall also confirm proper operation of the cards at the Advanced Traffic Controller in-cabinet using Owner supplied GRID software. Each card shall be monitored through the GRID software for a minimum of 5 minutes, and the detection observed shall closely approximate the real-time values observable simultaneously from within the cards' software interface.

7.3.7 Following successful calibration of the cards, the Contractor shall obtain confirmation from the Contract Administrator that the data from the magnetic detector cards is reported at the TOC.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.4	√		
5.1.1.7		√	
5.1.1.9		√	√
5.1.1.14		√	
5.1.1.15		√	

CLAUSE	PIT	POP	SIT
5.1.1.16		√	
5.2.1		√	
5.2.2		√	
5.2.3		√	
5.2.4		√	
7.3.1		√	
7.3.2		√	
7.3.3		√	
7.3.4		√	
7.3.5		√	
7.3.6		√ [1]	
7.3.7			√

Testing Footnotes:

[1] GRID software report shall be submitted as part of test results documentation.

8. QUALITY ASSURANCE - Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of magnetic cards is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work, except System Integration Testing which is paid for under a separate item.

No payment shall be provided as compensation for any labour, equipment and materials required for evaluation of alternative, non DSM listed product sources under this contract item.

WARRANT: Always with this item.

EXTRA LOW VOLTAGE CABLES FOR MAGNETIC DETECTORS, IN DUCTS - Item No.
EXTRA LOW VOLTAGE CABLES FOR MAGNETIC DETECTORS, IN DUCTS (TEMPORARY) – Item No.

Special Provision No. 682S32 February 2009

Amendment to OPSS 604, November 2008

604.02 REFERENCES

Section 604.02 of OPSS 604 is amended by the addition of the following:

International Municipal Signal Association (IMSA)

IMSA #50-2 Polyethylene Insulated, Polyethylene Jacketed, Loop Detector Lead-in Cable

Underwriters Laboratories Inc:

UL 83 Thermoplastic-Insulated Wires and Cables

OPSS 604 is amended by the addition of the following section:

604.04 DESIGN AND SUBMISSION REQUIREMENTS

604.04.01 Submission Requirements

The Contractor shall supply the specification sheets for the extra low voltage cable for magnetic detectors to the Contract Administrator prior to ordering.

604.05 MATERIALS

604.05.03 Extra Low Voltage Cables in Ducts

Subsection 604.05.03 of OPSS 604 is deleted and replaced with the following

604.05.03.01 Physical

Extra low voltage cables for use with magnetic detectors shall be AWG #18, four (4)-conductor, low capacitance cables suitable for outdoor in-duct installations.

Conductors shall be colour-coded as each conductor will be spliced to a different magnetic probe lead-in cable. The colours shall be black, red, white and green.

Conductors shall be stranded copper, twisted six (6) turns per 0.305 metres (1 foot).

Cables shall be shielded with aluminized polyester or equivalent material to protect against electromagnetic interference from other nearby cables.

604.05.03.02 Electrical

The extra low voltage cable for magnetic detectors shall be capable of conducting the magnetic induced signal to a distance of at least 760m.

The adjacent pair conductor-conductor capacitance shall be 30 pf per 0.305 metres (1 foot) +/- 10%.

The diagonal pair conductor-conductor capacitance shall be 27 pf per 0.305 metres (1 foot) +/- 10%.

The inductance shall be 23.5 uH per 30.5 metres (100 feet).

The ELV cable shall withstand voltages up to 600V described under UL 83 section 36.

604.07 CONSTRUCTION

604.07.10 Cables in Ducts

Subsection 604.07.10 of OPSS 604 is amended by the addition of the following:

Extra low voltage cables in ducts shall be installed in continuous runs from the magnetic detector lead-in cable splice point to the controller cabinet. Intermediate splices are not permitted unless otherwise indicated.

The installation of split duct protection around low voltage and extra low voltage cables installed in electrical chambers shall be carried out in accordance with the Contract Drawings.

604.10 BASIS OF PAYMENT

Section 604.10.01 of OPSS 604 is amended by the addition of following:

Extra Low Voltage Cables For Magnetic Detectors, In Ducts - Item No.

Section 604.10.02 of OPSS 604 is amended by the addition of following:

Extra Low Voltage Cables For Magnetic Detectors, In Ducts (Temporary) - Item No.

WARRANT: Always with these items

FLEXIBLE DUCTS BY SUBSURFACE INSTALLATION FOR MAGNETIC DETECTORS – Item No.
RIGID DUCTS, CONCRETE ENCASED FOR MAGNETIC DETECTORS - Item No.

Special Provision No. 682S33 February 2009

Amendment to OPSS 603, November 2008

OPSS 603 is amended by the addition of the following section:

603.04 DESIGN AND SUBMISSION REQUIREMENTS

The Contractor shall submit duct installation measurement records to the Contract Administrator. The Contractor shall initially provide one (1) hard copy and one (1) electronic copy in Excel format of all duct installations included in the Contract. The documentation shall be complete with all locations and all required measurements. No partial submissions will be accepted. For final submission, the Contractor shall provide two (2) hard copies and two (2) electronic copies of the documentation required for the submission.

603.05 MATERIALS

603.05.01 Concrete

Subection 603.05.01 of OPSS 603 is deleted and replaced with the following:

Concrete shall be according to OPSS 1350, rapid setting, high-early strength concrete with a compressive strength of 20 MPa.

Section 603.05 of OPSS 603 is amended by the addition of the following subsection:

603.05.11 Marking of Ducts Intended for Magnetic Detectors

Identification marker shall consist of a rectangular-shaped plate and flexible stake as shown in the Contract Drawing.

OPSS 603 is amended by the addition of the following section:

603.06 EQUIPMENT

Equipment used for flexible ducts by subsurface installation work shall be capable of maintaining depth and alignment of the ducts and measuring the depth of the installation at any location at any point along the duct axis.

603.07 CONSTRUCTION

Subsection 603.07.07 of OPSS 603 is deleted and replaced with the following:

603.07.07 Rigid Ducts, Concrete Encased for Magnetic Detectors

The Contractor shall notify the Contract Administrator 48 hours prior to initiating this work.

The duct and the concrete encasement under pavement for magnetic detectors shall be installed at depth as indicated elsewhere the Contract Documents. The duct shall maintain constant depth and direction. The horizontal or vertical deviation shall not exceed 20mm/m of duct length. If the road surface is crowned the depth shall conform to the shape of the crown. Ducts for the same detection station shall be installed 5 m apart measured between the centreline of both ducts.

The duct will be used for installation of magnetic detectors enclosed within cylinder shaped plastic carriers. Couplings used to connect lengths of ducts shall result in a smooth joint on the inside of the duct such that the detector carriers can slide freely over the joints.

Duct clips made of flexible, non-corrosive material shall be installed to prevent movement of duct during replacement of the concrete backfill in the trench. Duct clips shall be placed at 2m intervals along the entire run to ensure the duct is affixed firmly to the bottom of the trench.

The Contractor may pour the concrete directly into the trench. Concrete shall be placed according to OPSS 904 and Contract Drawings. The finish shall be raked or trimmed to produce a flat surface.

Contractor shall maintain a record of duct depth every 0.5m. The depth documentation results shall include the following:

- Detector Station ID Number
- Duct roadside ends GPS Coordinates
- Duct Location Station
- Depth of the duct from the road surface to the conduit centre line every 0.5m along the length of the traffic lanes
- Depth of duct at the centre of each traffic lane
- Width of each traffic lane and shoulders
- Distance between the two ducts comprising magnetic detection station at center of each lane
- Signature of the inspector who witnessed the installation and measurements

The duct shall extend 75 - 90mm into the handhole at each end of the duct. Each end of duct shall be capped with a press-fit cap.

For ducts installed in stages, the Contractor must plug the duct ends following each stage and install means of marking the location of the ducts such that they may be located during the next stage of construction.
If magnetic detectors are not installed as part of the Contract, at the completion of the duct length, the Contractor shall install fish line and 22AWG tracer wire.

603.07.09 Flexible and Rigid Ducts by Subsurface Installation

Subsection 603.07.09 of OPSS 603 is amended by addition of the following clause:

603.07.09.01 Flexible Duct by Subsurface Installation for Magnetic Detectors

The Contractor shall notify the Contract Administrator 48 hours prior to initiating this work.

The duct installed under pavement by directional drilling shall be installed at depth as indicated elsewhere in Contract Documents. The duct shall maintain constant depth and direction. The horizontal or vertical deviation shall not exceed 20mm/m of duct length. If the road surface is crowned the depth shall conform to the shape of the crown unless otherwise specified in the Contract. Ducts for the same detection station shall be installed 5m apart measured between centreline of both ducts.

The duct will be used for installation of magnetic detectors enclosed within cylinder shaped plastic carriers. The duct inner surface shall be smooth such that the detector carriers can slide freely over the length of the duct. The duct shall be continuous between the handholes. No splices are allowed.

The Contractor shall maintain a record of duct depth of every 0.5m. The depth documentation results shall include the following:

Detection Station ID Number
Duct roadside ends GPS Coordinates
Duct Location Station
Depth of the duct from the road surface to the conduit centre line every .5 m along the length of the traffic lanes
Depth of duct at the centre of each traffic lane
Width of each traffic lane and shoulders
Distance between the two ducts comprising magnetic detection station at center of each lane
Signature of the inspector who witnessed the installation and measurements

The duct shall extend 50 - 90mm into the handhole at each end of the duct. Each end of duct shall be capped with a press-fit cap.

If magnetic detectors are not installed as part of the Contract, at the completion of the duct length, the Contractor shall install fish line and 22AWG tracer wire.

603.07.17 End Marking

Subsection 603.07.17 of OPSS 603 is amended by addition of the following clause:

603.07.17.01 Marking of Duct Intended for Magnetic Detectors

All ducts runs intended for installation of magnetic detectors shall be marked with a flexible stake marker placed 2m or more beyond edge of shoulder and by 50mm x 50mm cut cross in the shoulder just outside edge of pavement line and on top of concrete barrier, where existing.

WARRANT: Always with these items

<u>FIBRE OPTIC COMMUNICATION CABLES, IN DUCTS</u> - Item No.
<u>FIBRE OPTIC COMMUNICATION CABLES, IN DUCTS (TEMPORARY)</u> - Item No.
<u>FIBRE OPTIC COMMUNICATION CABLES, AERIAL ON MESSENGER CABLE</u> – Item No.
<u>FIBRE OPTIC COMMUNICATION CABLES, AERIAL ON MESSENGER CABLE (TEMPORARY)</u> – Item No.

Special Provision No. 683S01 February 2009

1. SCOPE

This Special Provision covers the requirements for the installation, splicing and testing of the fibre optic communication cables to be placed in ducts. The requirements apply to various types of fibre optic cables as defined within this Special Provision. The messenger cable and fibre optic splice enclosure shall be supplied under separate tender items.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-455-B Standard Test Procedure for Fibre Optic Fibres, Cables, Transducers, Sensors, Connecting and Terminating Devices, and Other Fibre Optic Components

TIA/EIA-598-B Optical Fibre Cable Color Coding

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Branch Cable: means fibre optic cable interconnecting the trunk cable with communication equipment adjacent to pedestals through which the trunk cable does not pass. The cable composition is specified in the Contract Drawings.

Drop Cable: means fibre optic cable interconnecting the trunk cable or the branch cable with the Interconnect Centre in cabinets. The cable composition is specified in the Contract Drawings.

Patch Cord Cable: means fibre optic cable interconnecting the drop cable with the communication equipment in cabinets.

Trunk Cable: means fibre optic cable interconnecting the TOC communication equipment with the roadside communication equipment. The cable composition is specified in the Contract Drawings.

The number prior to the designator SM means the number of single mode fibres in the cable.

The number prior to the designator MM means the number of multimode fibres in the cable.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the fibre optic communication cables including colour coding and position of fibres and buffer tubes within the cable, drop cables, connectors, interconnect panels, terminating blocks and optical attenuators to the Contract Administrator for review prior to ordering.

5. MATERIALS

The Contractor will be allowed to supply different combinations of fibre optic cables to meet the Contract requirements. However, no compensation will be made for additional lengths of cable or surplus fibres resulting from such substitutions.

5.1 Trunk Cable, Branch Cable

5.1.1 The trunk and branch cables shall consist of all required optical SM or MM fibres divided into buffer tubes and housed within a protective cable structure suitable for installation in an outdoor underground ducts or aerial on steel messenger cable. All fibre optic trunk and branch cable shall include a twisted pair cable within the space allocated for one buffer tube for cable locating purposes.

5.1.2 The cables shall be rated for operation over a temperature range of - 30^{o} C to + 60^{o} C.

5.1.3 The cables shall provide mechanical support and protection for the specified number of fibres.

5.1.4 The outer jacket of the cables shall be constructed of medium or high density polyethylene and provide UV resistance to allow aerial installation.

5.1.5 The cables shall be able to withstand a maximum pulling tension of 2500 N during installation without any resulting damage.

5.1.7 The minimum static bending radius for the cables under no tension shall be 200 mm. The minimum bending radius during installation and under tension shall be 300 mm.

5.1.8 All interstices within the cable’s outer jacket shall be filled with a compound to prevent the ingress and migration of water. The compound shall be nontoxic and dermatologically safe. Some leakage of the compound is permitted, however, there shall be no bulk flow of compound out of the cable over the specified operating temperature range which could impact on the waterproofness of the cable.

5.1.9 Materials used in the cables shall not produce hydrogen in a concentration large enough to cause any degradation in the transmission performance of the optical fibres.

5.1.10 Materials used in the cables shall not support galvanic action.

5.1.11 Fibres shall be bundled in buffer tubes. Each buffer tube shall contain 12 fibres.

5.1.12 Each individual fibre in the cables shall be identified by means of colour coding or a combination of colour and positional coding in accordance with TIA/EIA-598-B. The single mode fibre(s) shall be installed in the first buffer tubes. The ground trunk shall be located at one end of the cable.

5.2 Drop Cable

5.2.1 The Drop Cable shall consist of all required optical SM or MM fibres housed in a protective armoured jacket rated for outdoor installation in underground conduits and UV stable for aerial installation on steel messenger cable. The cabinet end of the fibre shall be connectorized, the other end shall be spliced into a Trunk or Branch Cable.

5.2.2 The attenuation of drop cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 850 nm and 1310 nm.

5.2.3 Fibres shall be protected with a 900µm tight buffer, surrounded by an aramid or kevlar yarn strength member and an armoured jacket. Connectors shall be securely fastened to the strength member.

5.2.4 The drop cable shall be suitable for operation over the temperature range of -30^{o} C to +60^{o} C.

5.2.5 The exact number of drop cables at each pedestal, communications box and at the TOC shall be in accordance with the Contract. The Contractor is free to employ the most efficient means of meeting the drop cable requirements, as approved by the Contract Administrator.

5.2.6 Drop cables shall be of length suitably long to be connected to the rack mounted interconnect panel. Sufficient slack shall be left at each end to allow removal of the splice enclosure and tray, and relocation of the equipment anywhere within the cabinet.

5.3 Fibre Optic Patch Cord Cable

5.3.1 The fibre optic patch cord cables shall consist of optical SM or MM fibres housed individually in protective armoured jackets. Both ends of the cable shall be connectorized.

5.3.2 The attenuation of a fibre optic patch cord cable after installation, not including the connector loss, shall not exceed 0.1 dB measured at 850 nm and 1300 nm.

5.3.3 The fibre optic patch cord cable shall be suitable for operation over the temperature range of - 30^{o} C to + 60^{o} C.

5.3.4 Fibre optic patch cord cables shall be of length suitably long to be connected between the rack mounted interconnect panel and the communication equipment (e.g. modems, etc.). Sufficient slack shall be left to allow relocation of the equipment anywhere within the cabinet.

5.4 Single Mode (SM) Cabled Fibre

5.4.1 The mean optical attenuation at 1310 nm shall not be greater than 0.4 dB/km with a standard deviation not greater than 0.05 dB/km. The maximum attenuation of any continuous length of SM fibre at 1310 nm shall not exceed 0.45 dB/km.

5.4.2 The mean optical attenuation at 1550 nm shall not be greater than 0.3 dB/km with a standard deviation not greater than 0.06 dB/km. The maximum attenuation of any continuous length of SM fibre shall not exceed 0.36 dB/km.

5.4.3 The fibre attenuation shall not vary more than 0.2 dB/km over the specified cable operational temperature range.

5.4.4 The single mode (SM) fibres shall have a step refractive index profile.

5.4.5 The SM fibre shall consist of a glass core surrounded by a glass cladding surrounded by a polymer coating. If tight buffering of the SM fibre is used, the buffering material may be considered to be the polymer coating.

5.4.6 The SM fibre core shall have a diameter of between 8.3 to 9 µm inclusive with a tolerance of ± 1.3 µm.

5.4.7 The SM fibre cladding shall have an outer diameter of 125 µm with a tolerance of ± 3 µm.

5.4.8 The core eccentricity shall be less than or equal to 1.0 µm.

5.4.9 The SM fibre shall be coated with a protective polymer to preserve the strength of the fibre. The coating shall be removable by mechanical or chemical means. The coating shall retain its colour when subject to the manufacturer's recommended fibre cleaning and splicing preparation methods.

5.4.10 The SM fibre shall have attenuation and bandwidth specified at two wavelength windows.

5.4.11 The first wavelength window shall be at and around 1310 nm.

5.4.12 The second wavelength window shall be at and around 1550 nm.

5.4.13 The fibre optical bandwidth at 1310 nm or 1550 nm shall be equal to or greater than 1000 MHzkm.

5.4.14 The zero dispersion wavelength shall be at a wavelength of 1310 ± 10 nm.

5.4.15 The maximum dispersion at 1550 nm shall not exceed 18 ps/nmkm.

5.4.16 The maximum dispersion in the wavelength range of 1285 to 1330 nm shall not exceed 3.2 ps/nmkm.

5.5 Multimode (MM) Cabled Fibres

5.5.1 The mean optical attenuation for cables at 850 nm shall be not greater than 3.2 dB/km with a standard deviation not greater than 0.3 dB/km. The maximum attenuation of any fibre shall not exceed 3.5 dB/km.

5.5.2 The mean optical attenuation for cables at 1310 nm shall not be greater than 1.0 dB/km with a standard deviation not greater than 0.2 dB/km. The maximum attenuation of any fibre shall not exceed 1.5 dB/km.

5.5.3 The fibre attenuation shall not vary more than ± 0.2 dB/km over the specified cable operational temperature range.

5.5.4 MM fibres shall have a graded refractive index profile.

5.5.5 The MM fibre shall consist of a glass core surrounded by a glass cladding surrounded by a polymer coating. If tight buffering of the MM fibre is used, the buffering material may be considered to be the polymer coating.

5.5.6 The MM fibre core shall have a diameter of 62.5 µm with a tolerance of ± 3 µm.

5.5.7 The MM fibre cladding shall have an outer diameter of 125 µm with a tolerance of ± 3 µm.

5.5.8 The MM fibre core shall have a theoretical numerical aperture of 0.275.

5.5.9 The core eccentricity shall not exceed 7.5%. The typical eccentricity shall be not greater than 2%.

5.5.10 The core non-circularity shall be less than 2%.

5.5.11 The MM fibre shall be coated with a protective polymer to preserve the strength of the fibre. The coating shall be removable by mechanical or chemical means. The coating shall retain its colour when subjected to the manufacturer's recommended fibre cleaning and splicing preparation methods.

5.5.12 The polymer coating shall have an outer diameter of at least 230 µm.

5.5.13 The MM fibre shall have attenuation and bandwidth specified at two wavelength windows.

5.5.14 The short wavelength window shall be at and around 850 nm.

5.5.15 The long wavelength window shall be at and around 1310 nm.

5.5.16 The fibre optical bandwidth at 850 nm shall be equal to or greater than 200 MHzkm.

5.5.17 The fibre optical bandwidth at 1310 nm shall be equal to or greater than 500 MHzkm.

5.6 Twisted Pair Cable

5.6.1 The conductors of the cable shall be 22 AWG copper, PVC insulated, twisted and unshielded.

5.6.2 The cable shall meet the environmental requirements of the fibre optic cable.

5.6.3 Each conductor of the cable shall be identified by means of colour coding.

5.6.4 Nominal conductor resistance in any length of completed cable shall not exceed 57 ohms/km at 20^{o}C.

5.7 Connectors

5.7.1 Connectors shall all be ST style unless otherwise specified in the Contract.

5.7.2 Connectors shall have a ceramic ferrule with a nickel plated nut and body.

5.7.3 The connector mean loss shall not be greater than 0.5 dB with a standard deviation of not greater than 0.2 dB. The connector loss shall not vary more than 0.2 dB over the operating temperature range.

5.7.4 The connectors shall be compatible with a physical contact (PC) finish. All connectors shall be polished to a PC finish such that the return loss per mated pair of connectors is at least 25 dB. The return loss when the connector is mated with previously installed connectors shall be at least 18 dB.

5.7.5 Index matching fluids or gels shall not be used.

5.7.6 The connector loss shall not vary more than 0.2 dB after 1000 repeated matings.

5.7.7 The connector shall withstand an axial load of 135 N.

5.7.8 The connectors shall be compatible with the optical fibre surrounding jacket and shall be installed on one end of the optical fibre in accordance with the manufacturer's recommended materials, equipment and practices.

5.7.9 The connector shall be suitable for the intended environment and shall meet the following environmental conditions.

5.7.10 Operating temperature: -30^{o} C to $+60^{o}$ C.

5.7.11 Connectors shall be protected by a suitably installed waterproof protection cap.

5.8 Number of Fibres

The number of SM and MM fibre specified for each cable shall be the guaranteed number of SM and MM fibres, (i.e. SM and MM fibres in the cable shall comply with the specification after installation).

5.9 Fish Line

Fish Line shall be nylon or polypropylene material with a minimum test strength of 400 N.

5.10 Packing and Shipment

The cable shall be supplied on reels. Each reel shall have the following information clearly labelled on it in:

a) Customer
b) Customer order number
c) Reel number
d) Destination
e) Ship date
f) Manufactured date
g) Manufacturer’s name
h) Cable code
i) Length of cable

5.11 Rack Mounted Interconnect Centre/Panel

5.11.1 Each cabinet location with drop cables shall include a rack mountable interconnect centre complete with connector panels.

5.11.2 Each interconnect centre shall have capacity for 24 connections and shall include the fibre optic through adapters for 24 fibres or suitable capacity for all drop cables as specified in the Contract if more than 24 fibre drop cables need to be interconnected at cabinet.

5.11.3 Each field interconnect panel shall be compatible for connection to the ST style connectors of the fibre drop cables and fibre optic patch cord cables.

5.11.4 Each central interconnect panel shall be compatible for connection to the FC style connectors of the fibre drop cables and fibre optic patch cord cables.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 General

7.1.1 Cable shall be transported to site using cable reel trailers.

7.1.2 Care shall be taken at all times to avoid scraping, denting, or otherwise damaging the cable before, during or after installation. Damaged cable shall be replaced by the Contractor without additional compensation.

7.1.3 The Contractor shall not exceed the manufacturer's recommended safe pulling tension and minimum bending radius at any time.

7.1.4 Sufficient slack shall be pulled to allow cable cutting and connection to communications equipment.

7.1.5 The Contractor shall install optical attenuators as required, in order to ensure operation within the operating window of the proposed equipment, while maintaining a 3 dB margin at high and low ends. The Contractor shall record locations where attenuators are installed.

7.1.6 Twisted pairs shall be terminated at the termination block in each pedestal. The termination blocks shall be installed in pedestals external to the splice enclosures in accordance with the Contract Drawings and as approved by the Contract Administrator. All connections shall be clearly identified.

7.1.7 All cable ends shall be protected from moisture ingress by using properly sealed caps.

7.2 Installation in Ducts

7.2.1 Cable shall be installed in duct in the field in accordance with the Contract Drawings. The duct network consists of rigid duct between the TOC, pedestals, communications cabinets and electrical chambers as shown on the Contract Drawings.

7.2.2 The Contractor shall ensure that all duct ends are smoothed prior to installation of the cables to prevent scraping the cable.

7.2.3 A stiff bristle brush shall be pulled through each section of duct before pulling cable.

7.2.4 A manufacturer recommended lubricant shall be applied to the cable to reduce friction between the cable and the duct.

7.2.5 The Contractor shall install plastic inner chamber inside ducts where drop cables are to be installed.

7.2.6 Drop cables (in plastic inner chamber) shall be manually pulled from the cabinet to the pedestal to prevent the connectors from being damaged. Clips shall be provided to support all drop cables.

7.2.7 Where fibre optic cables (trunk, branch or drop) are required to be installed in inner duct, the Contractor shall secure each section of inner duct to prevent it from being pulled with the cables.

7.2.8 A cable grip shall be attached to the cables so that no direct force is applied to the optical fibre. The cable grip shall have a ball bearing swivel to prevent the cable from twisting during pulling.

7.2.9 Cable rollers and feeders and winch cable blocks shall be used to guide the cable freely into the duct and at electrical chamber locations.

7.2.10 Mechanical aids and pulling cable or ropes shall be used as required.

7.2.11 Personnel equipped with two-way radios shall be stationed at each electrical chamber, cabinet, pedestal through which the cable is to be pulled to observe and lubricate the cable.

7.2.12 Cable passing through electrical chambers shall be installed in split duct and shall have sufficient slack for expansion and Contraction. The split duct shall be installed on the electrical chamber wall opposite the power cables and ladder rungs using galvanized steel conduit straps. The split duct shall clearly identify the contents to be fibre optic cable.

7.2.13 Where mechanical pulling is required (i.e. all runs greater than 50 m), a dynamometer shall be used to record installation tension and a tension limiting device shall be used to prevent exceeding the maximum pulling tension as defined by the cable manufacturer. The maximum pulling tension shall be recorded for each run of cable. The cable shall be taken up at intermediate pulling points with an intermediate cable take-up device as approved by the Contract Administrator to prevent over tension on the cable. Cable pulls shall be continuous and steady between pull points and shall not be interrupted until the entire run of cable has been pulled.

7.2.14 The cable shall be securely fastened in place within electrical chambers, pedestals and cabinets. For vertical conduit runs, the cable installation shall include installation of strain relief mechanism.

7.2.15 The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the communication equipment and the splice enclosures including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the splice enclosure for future splicing.

7.2.16 The unconnectorized end of the drop cable shall be spliced to the trunk or branch cable fibres in accordance with the Contract.

7.2.17 The individual drop cables shall be labelled with permanent indelible ink or marking tape to indicate fibre number, to which subsystem and Trunk or Branch Cable fibre the Drop Cable is connected to and the cabinet number for the other end of the link, as indicated in the Contract Drawings.

7.2.18 The Contractor shall label the interface fibres in the interconnect centre. The labelling scheme selected shall clearly identify the fibre number and connecting device. The labelling scheme is to be approved by the Contract Administrator.

7.2.19 Spare drop cable fibres indicated in the Contract shall be connectorized and connected to the spare ports of the interconnect centre/panel in the cabinet.

7.2.20 Direct connectorization of a multimode drop cable will be permitted if the optical fibre is continuously surrounded with a length of strengthening material and a jacket.

7.2.21 Following installation of the cable in the ducts, all duct entrances at pedestals and cabinets shall be sealed with duct sealing compound to prevent the ingress of moisture, foreign materials, and rodents.

7.2.22 10 m of each cable going to and coming from each pedestal shall be coiled in the first electrical chamber on each side of each pedestal. In addition, 25 m of cable shall be left coiled in the first electrical chamber on each side of all surface mounted conduit systems.

7.2.23 Where trunk cable terminations are left “dead ended”, 25 m of cable shall be left coiled.

7.2.24 All coiled cables shall be securely fastened in place with a minimum of four galvanized steel conduit straps.

7.2.25 Fish line shall be installed in all communications ducts or conduits along with fibre optic communication cables. A 2.0 m length of fish line shall be left coiled, tied and accessible in each cabinet, pedestal, electrical chamber and junction box. The fish line shall be installed according to manufacturer’s specifications and shall be "free" and NOT helical about communications cables.

7.2.26 At intermediate pulling points, to prevent over-tension on the cable, the cable shall be either taken up with an intermediate cable take up device as approved by the Contract Administrator, or all excess cable shall be laid out on the ground in a “figure eight” configuration before subsequent installation.

7.2.27 The Contractor may remove the pedestals to assist in the installation. If this option is exercised, all removed pedestals shall be reinstalled to their original condition including caulking of the pedestal base.

7.2.28 Unless otherwise noted in the Contract, the temporary fibre cable and associated drop cables shall be removed and delivered to the Owner at the location specified by the Contract Administrator.

7.3 Aerial Installation

7.3.1 The cable shall be installed on messenger cable in accordance with the Contract Drawings.

7.3.2 The Contractor shall be responsible for ensuring the cable length is sufficient to allow for connection between the pedestals or splice enclosures as shown in the drawings including provision for slack, vertical runs, cable necessary for splicing, wastage and cable to allow for the removal of the splice enclosure to the ground level for future splicing.

7.3.3 25m of fibre optic cable shall be coiled at the first pole of transition between underground and aerial installation.

7.3.4 Unconnectorized ends of the drop cables shall be spliced to the trunk or branch cable fibres in accordance with the Contract.

7.3.5 The individual drop cables shall be labelled with permanent indelible ink or marking tape to indicate fibre number, to which subsystem and Trunk or Branch Cable fibre the Drop Cable is connected to and the cabinet number for the other end of the link, as indicated in the Contract Drawings.

7.3.6 The Contractor shall label the fibre patch cords in the interconnect centre. The labelling scheme selected shall clearly identify the fibre number and connecting device.

7.3.7 Direct connectorization of a multimode drop cable will be permitted if the optical fibre is continuously surrounded with a length of strengthening material and a jacket.

7.3.8 Unless otherwise noted in the Contract, the temporary aerial cable and associated drop cables shall be removed and delivered to the Owner at the location specified by the Contract Administrator.

7.4 Installation in the Traffic Operations Centre

At the TOC, cables shall be installed from the existing indoor slice enclosures to the communications equipment as indicated in the Contract Drawings.

7.5 Splicing

7.5.1 Only the splices indicated in the Contract Drawings shall be allowed.

7.5.2 All pedestal and aerial splices shall be housed in an outdoor splice enclosure in accordance with the Contract. All splices in the TOC shall be housed in indoor splice enclosures.

7.5.3 The splices shall be performed by high quality fusion type splicing equipment.

7.5.4 The maximum loss introduced by any singlemode splice shall not exceed 0.25 dB at 1310 nm and 1550 nm.

7.5.5 The average singlemode splice loss shall not exceed 0.1 dB for any given span, with a standard deviation not greater than 0.07 dB.

7.5.6 The maximum loss introduced by any multimode splice shall not exceed 0.3 dB/km at 850 nm and 1550 nm.

7.5.7 The average multimode splice loss shall not exceed 0.2 dB for any given span.

7.5.8 Only the fibres required to be spliced to drop cables indicated in the Contract shall be severed and spliced. Where required, the buffer tube splitting tool recommended by the manufacturer shall be used to open the correct buffer tube. Unsevered fibres in an open buffer tube shall be coiled in the splice tray. When buffer tubes do not need to be opened, at least 4.0 m of unopened buffer tubes shall be coiled in the fibre optic splice enclosure. The Contractor shall prepare the designated fibres of the cable for splicing to the drop cables following manufacturer recommended procedures. All splices shall be arranged neatly in splice trays, supported and protected with a suitable splice protector. At least 1.0 m of each fibre shall be stored in the splice tray.

7.5.9 Each splice shall be tested for tensile strength by applying a force of not less than 200 grams.

7.5.10 Drop cable entrances to the splice enclosures shall adhere to the manufacturer’s recommendations for the type of cable and inner duct selected.

7.5.11 In order to reduce the overall number of splices required, the cable shall be installed in continuous lengths with a minimum average of 2 km. The Contractor shall attempt to maximize the runs of cable beyond the minimum requirements. Locations for trunk cable splicing shall be approved by the Contract Administrator and documented as part of as-constructed documentation.

7.5.12 The individual fibres shall be spliced and connected so that a constant identification scheme of the fibres to each subsystem (i.e. VMS, VDS, etc.) is maintained throughout the system. Fibre identification shall be in accordance with the Contract Drawings.

7.6 Interconnect Centre/Panel

7.6.1 The Interconnect Centre/Panel shall be used as a fibre optic 'Patch Panel'.

7.6.2 All drop cables entering a cabinet shall connect to the interconnect centre / panel.

7.6.3 All fibre optic patch cord cables between the interconnect centre and fibre optic communication equipment shall exit the interconnect centre via the interconnect panel.

7.6.4 The unused ports of the interconnect panel shall be provided with dust jackets for protection.

7.7 Grounding

7.7.1 All metallic components in the fibre optic cables shall be bonded to ground in the splice enclosures and communications pedestals.

7.7.2 The twisted pair cable for all types of cables shall be terminated at the pedestal and grounded to the pedestal ground log as shown in the Contract Drawings.

7.8 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated. All measurements shall be performed in accordance with EIA/TIA-455-B standard.

CLAUSE	PIT	POP	SIT
5.2.2	√	√	
5.3.2	√	√	
5.4.1	√ [2]	√ [2]	
5.4.2	√ [1]	√ [2]	
5.4.3	√ [1]	√ [2]	
5.5.1	√ [1]	√ [2]	
5.5.2	√ [1]	√ [2]	
5.5.3	√ [1]	√ [2]	
5.7.3		√	
5.7.4		√	
5.7.7		√	
7.2.14		√ [4]	

CLAUSE	PIT	POP	SIT
7.5.4		√ [3]	
7.5.5		√ [3]	
7.5.6		√ [3]	
7.5.7		√ [3]	
7.5.9		√ [3]	

Testing Footnotes:

[1] Each reel shall be tested prior to installation in ducts. PIT shall include a minimum of 10% of the total fibre optic communication cable. Where 10% equates to more than one fibre, the fibres to be tested shall be located in different buffer tubes.

[2] Each length of fibre cable shall be tested after installation in ducts. POP shall include a minimum of 10% of the single mode fibres and 10% of multi mode fibres to be connected to equipment. Contractor shall not test the same fibres on consecutive lengths. 100% of the spare cables shall be tested. The Contractor shall record the reel number from which the cable came, the identification of the fibres measured and the attenuation in dB/km of the fibres measured.

[3] Each optical link (fibre link terminated with optical connectors) shall be tested. Attenuation and continuity shall be demonstrated at wavelength of equipment which is to use the link being measured. Calibration between the light source and power meter shall be performed at the beginning of each day of testing and after every 20 optical link measurement.

The OTDR test results shall include the following measurements:

a) Total length of the optical link
b) Total attenuation of the optical link
c) Attenuation of each splice in the optical link under test
d) Attenuation per kilometre of the optical link under test
e) Wavelength of the Measurement
f) Index of Refraction used for the test

Test results shall include electronic and printed copies of the OTDR attenuation profile.

When cable installed in this Contract interconnects with existing cable, the Contractor will be provided with test results for existing adjacent communications cable. Contractor shall review the results prior to interconnecting to the existing cable.

The Contractor shall submit a certificate confirming the calibration of the test equipment within the past year prior to undertaking any testing.

[4] Pulling tension records shall be included in POP test results.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of cables shall be made horizontally in metres along the longitudinal axis of the duct trench from centre to centre of poles, electrical chambers, concrete pads and to the face of bridge structures and retaining walls.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work regardless of the type or number of fibres in the cable (connecting to both new and existing trunk cable), splices, twisted pair cable, termination blocks, coils of cable, attenuators, mechanical support, delivery, installation, testing and the production of all drawings, text and test results.

Progress payment for temporary fibre optic cables shall be based on the following percentages of the Contract price:

80% for supply and installation

20% for removal

WARRANT: Always with this item.

SPLICE ENCLOSURES FOR FIBRE OPTIC CABLES - Item No.

Special Provision No. 683S02 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation of splice enclosures for fibre optic cables.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the splice enclosures for fibre optic cables to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Outer Enclosure

5.1.1 The outdoor splice enclosure shall be suitable for outdoor applications with a temperature range of -40^{o} C to + 70^{o} C.

5.1.2 The outdoor splice enclosure shall fit into the pedestals and provide sufficient space to allow entry of fibre optic cable without exceeding the cable minimum bending radius. The enclosures shall be compatible with both through and butt splicing of the cable. The end plate shall consist of two sections and shall be capable of terminating all fibre optic cables as shown on the drawings.

5.1.3 The outer enclosure shall protect the splices from moisture and mechanical damage and shall be resistant to salt corrosion. All materials in the enclosure shall be nonreactive and shall not support galvanic cell action.

5.1.4 The enclosure shall be waterproof, re-enterable, re-sealable and shall be sealed with a gasket.

5.1.5 The enclosure shall permit selective splicing to allow one or more fibres to be cut and spliced to the drop cable without disrupting other fibres.

5.1.6 The outer enclosure shall have strain relief for the trunk cable to prevent accidental tension from disturbing the splices.

5.2 Splice Tray

5.2.1 The splice tray shall be compatible with the outer enclosure and be constructed of rigid plastic or metal. The number of splice trays per enclosure shall accommodate the number of splices required under the Contract.

5.2.2 Single mode and multimode fibres shall be spliced on separate trays.

5.2.3 Polyethylene tubes shall be supplied to protect exposed individual fibres within the enclosure.

5.2.4 Vinyl markers shall be supplied to identify each fibre to be spliced within the enclosure.

5.2.5 Each splice shall be individually mounted and mechanically protected on the splice tray.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation in Pedestals

7.1.1 The Contractor shall install the outdoor splice enclosure in the pedestals where splicing is required. The outdoor splice enclosure shall be securely fastened to the pedestal.

7.1.2 The outdoor splice enclosure shall be mounted in an upright position to allow the cable to enter at the bottom of the enclosure without exceeding the cable manufacturer's minimum bending radius. A sufficient cable length shall be coiled in the pedestal to allow the outdoor splice enclosure to be removed from the pedestal for splicing.

7.2 Aerial Installation

7.2.1 The Contractor shall attach the outdoor splice enclosure to the messenger cable where fibre optic cable is installed, as shown in the drawings.

7.2.2 A sufficient cable length shall be coiled to enable removal of the enclosure to the ground level for splicing. The cable slack shall be securely fastened to the messenger cable such that no strain is applied to the cable. The Contractor shall take care not to exceed the cable manufacturer's recommended minimum bending radius.

7.3 Communication Boxes

The Contractor shall install the outdoor splice enclosure in the communications boxes where cabinets are mounted on retaining wall platforms. The cable shall enter at one end of the outdoor splice enclosure and exit from the other end. Sufficient cable shall be coiled in the communications box for splicing. The Contractor shall take care not to exceed the cable manufacturer's recommended minimum bending radius.

7.4 Grounding

The outdoor splice enclosure shall be bonded to the pedestal ground or the controller cabinet ground, as applicable.

7.5 Splice Trays

7.5.1 The fibres exposed for splicing within the enclosure shall be protected from mechanical damage using the fibre support tube or tubes and shall be secured within the splice trays. The fibres shall be labelled with vinyl markers according to the identification scheme indicated in the Contract.

7.5.2 Upon completion of the splices, the splice trays shall be secured to the outer enclosure meeting the requirements specified by the manufacturer.

7.6 Sealing the Enclosure

7.6.1 The enclosure shall be sealed as recommended by the manufacturer. The enclosure shall provide a moisture proof environment for the splices.

7.6.2 Care shall be taken at the cable entry points to ensure that a tight salt resistant and waterproof seal is made which will not leak upon aging. Where multiple single fibre drop cables enter the splice enclosure, they shall be contained in the plastic inner duct, which shall be sealed into the fibre optic splice enclosure in the same manner as the trunk cables.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of splice enclosures is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work.

WARRANT: Always with this item.

<u>DATA INTERFACE CABLES</u> - Item No.

Special Provision No. 683S03 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of connectorized data cables for interfaces as shown in the Contract Drawings and detailed in the equipment specifications.

2. REFERENCES

This Special Provision refers to the following standards, specifications and publications:

Canadian Standards Association:

CSA Standard C22.2 No. 65-03	Wire Connectors (Tri-National Standard, with UL486A-486B and NMX-J-543-ANCE-03)

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the data interface cables to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Cable

5.1.1 The cable installed shall be capable of transmitting data at the rate of its intended use.

5.1.2 The cable shall contain ten conductors of datalene insulated 24 AWG stranded tinned copper conductors. Conductors shall be colour coded.

5.1.3 The jacket shall be constructed of PVC.

5.1.4 The shield shall consist of an overall aluminium-polyester shield and an overall tinned copper braid. A 24 AWG stranded tinned copper drain wire shall be provided.

5.1.5 The outer diameter shall not be greater than 8.5 mm and shall be suitable for attachment to the connectors.

5.1.6 The interconductor capacitance shall not be greater than 40 pF/m.

5.1.7 The capacitance between any conductor and the shield shall not be greater than 73 pF/m.

5.1.8 Cable lengths shall be appropriate for the interface requirements. Cable between equipment in separate cabinets shall be supplied with 2 m of slack.

5.1.9 The cable shall be temperature rated from -30^{o} C to +50^{o} C.

5.2 Connectors

5.2.1 Cable connectors shall meet the requirements of CSA Standard C22.2 No. 65.

5.2.2 For cables interfacing with Controller units the connector shall be 9 pin D-type female. Other connectors shall be 25 pin D-Type. All connectors shall have a metallic shield and shall be capable of fastening to the mating device such that pulling on the cable or connector does not result in a loss of connection. The connector shall be male or female as required by the mating device and shall be supplied with solderless, gold plated pins or receptacles respectively which shall be capable of being relocated in the connector housing.

5.2.3 The connectors shall be temperature rated from -30^{o} C to +50^{o} C.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Connectorization

7.1.1 The shield shall be connected to pin 1 at one end only.

7.1.2 Pins 2, 3, 4, 5, 6, 7, 8 and 20 shall be connected at each end of one conductor of separate twisted pairs. Where a 9-pin D-type connector is required, pins 1, 2, 3, 4, 5, 6, 7 and 8 shall be connected. Any conductor shall be capable of being reconnected to any pin in the connector housing. Pins shall be crimped to both the insulation and the conductor.

7.1.3 The Contractor shall confirm the terminating equipment for all data interface equipment (e.g. DCE, DTE) at all data interface cable locations. All necessary cross connections shall be provided (e.g. Tx crossed to Rx) within the connector. Each cable shall be appropriately labelled at both ends as a ’modem’ or ’null modem’ cable according to the cross connections above.

7.1.4 At locations with port sharing devices, the separate port connectors shall have the CA (request to send) and CB (clear to send) circuits shorted within the connector. The separate port connectors shall be clearly labelled as ’PSD Separate Ports’.

7.1.5 Cable shall be secured within the connector housing to prevent stress on the connections.

7.2 Installation

7.2.1 All interface cables shall be installed between data ports in accordance with the drawings.

7.2.2 Cables shall be installed neatly between adjoining equipment and shall be secured to rigid structures using appropriate fastening devices. Cable and connectors shall not be stressed during or after installation.

7.2.3 Similar cables between common locations shall be grouped together with cable ties. All interface cables shall be uniquely identified at both ends with vinyl cable markers. Cable routing shall be approved by the Contract Administrator.

7.2.4 All interface cables in the TOC shall be routed beneath the raised floor and shall not be routed in parallel to power cables or crossed over video cables.

7.2.5 Power cables and data interface cables installed in cabinets shall be routed on opposite sides of the cabinets.

7.2.6 2.0 m of slack cable coiled neatly shall be provided between equipment in separate cabinets.

7.3 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1		√	

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work.

WARRANT: Always with this item.

<u>VIDEO TRANSMITTERS AND RECEIVERS</u> - Item No.

Special Provision No. 683S04 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of the Video Transmitters and Receivers. A Video Transmitter and Receiver shall be interconnected by optical fibre to form a video link.

The video link is to provide point-to-point transmission and reception of a full motion NTSC baseband video signal using an optical fibre as the transmission medium.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-250-C Electrical Performance for Television Transmission Systems

EIA-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the video transmitters and receivers, for approval prior to ordering.

5. MATERIALS

5.1 Video Transmitters

5.1.1 General

5.1.1.1 The video transmitter shall accept any NTSC baseband video signal and convert it into a signal suitable for launching into an optical fibre.

5.1.1.2 The video transmitter shall accept a composite input video signal at a level of 1.0 V + 3 dB peak to peak referenced sync tip to reference white and shall continue to operate with an input level of 1.0 V + 6 dB.

5.1.1.3 The input impedance shall be 75 ohms and the return loss shall be at least 30 dB in compliance with EIA standard EIA/TIA-250-C for an unbalanced-to- ground connection.

5.1.1.4 The optical emitter shall be coupled to an ST style compatible coupling or panel mount receptacle mounted on the video transmitter.

5.1.1.5 The video transmitter shall have visible panel indicators for "Primary power ON" and "Power supply failed".

5.1.1.6 The video transmitter shall include all mounting hardware and shelves necessary to mount it in the EIA standard 480 mm equipment rack in each cabinet.

5.1.1.7 The printed circuit boards shall be conformal coated or mounted in sealed containers.

5.1.1.8 The video transmitter shall accept the video input through a stainless steel bulkhead female BNC style electrical connector.

5.1.1.9 The video transmitter shall have an optical emitter, which shall have a centre wavelength at, or around 1310 nm at 25^{o}C.

5.1.1.10 The video transmitter launch power shall be defined as the power launched into one metre of graded index optical fibre with a nominal core dimension of 62.5 µm, a nominal cladding dimension of 125 µm and a theoretical numerical aperture of 0.275.

5.1.1.11 The video transmitter shall include a power supply. The power supply may be external to the rest of the video transmitter components.

5.1.1.12 The power supply shall receive its power from a 120 VAC 60 Hz 5-15R power receptacle.

5.1.1.13 The power supply shall supply all voltages required by the video transmitter for operation.

5.1.2 Long Range Video Transmitters

5.1.2.1 The long range video transmitter shall pulse frequency modulate (PFM) the baseband video signal onto an optical fibre for transmission to the long range video receiver.

5.1.2.2 The long range video transmitter launch power shall be at least 22 dB greater than the long range video receiver sensitivity.

5.1.2.3 The video transmitter shall operate in conjunction with the long range video receiver through an optical communication channel with an optical bandwidth of 70 MHz while maintaining the video receiver performance specifications.

5.1.3 Short Range Video Transmitters

5.1.3.1 The short range video transmitter shall pulse frequency modulate (PFM) the baseband video signal onto an optical fibre for transmission to the short range video receiver.

5.1.3.2 The short range video transmitter launch power shall be at least 10 dB greater than the short range video receiver sensitivity.

5.1.3.3 A long range video transmitter may be substituted for a short range video transmitter if the short range video receiver is also substituted with a long range video receiver.

5.2 Video Receiver

5.2.1 General

5.2.1.1 The video receiver shall receive the optical signal launched into an optical fibre by the video transmitter.

5.2.1.2 The receiver shall be coupled to an ST style compatible connector or panel mount receptacle mounted on the video receiver.

5.2.1.3 The video receiver shall output an electrical baseband NTSC video signal through a BNC type connector.

5.2.1.4 The video receiver shall have a dynamic range of at least 10 dB and shall have an adjustable range of at least 15 dB, which may be complied with by use of optical attenuators.

5.2.1.5 The video receiver sensitivity shall be defined as the minimum optical power required to be received by the Video Receiver from the video transmitter to operate at or better than the minimum video link performance specifications.

5.2.1.6 Should the Contractor choose to power multiple video receiver cards from one power supply, a redundant power supply shall be provided. A redundant power supply shall consist of two individual power supplies designed so that if one supply fails the remaining power supply will automatically provide sufficient power to operate all modules.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Video transmitters and receivers shall be installed at the cabinet locations and at the TOC.

7.2 The Contractor shall connect the correct Drop Cable to the optical connector on the video transmitters and video receivers.

7.3 The drawings show the equipment space envelope allocated to the video transmitters for typical cabinet layouts. The Contractor shall coordinate the physical space required by the video transmitter with the allocated space.

7.4 The Contractor shall connect the video transmitter power supply to one of the 115 VAC 60 Hz power distribution panel receptacles reserved for communications equipment in the cabinet.

7.5. The fibre optic links for each video link shall have been tested and verified in accordance with the Contract prior to video receiver or video transmitter installation.

7.6 The Contractor shall neatly train all drop cables together when routing them along the same path and shall neatly train them along the support rails of the equipment rack.

7.7 No cables shall be installed with a bending radius less than the manufacturer's minimum recommended bending radius.

7.8 The Contractor shall integrate the video transmitter with the CCTV equipment and communication network.

7.9 The Contractor shall integrate the video receiver with the CCTV display equipment and communication network.

7.10 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.1	√	√	
5.1.1.2	√	√	
5.1.1.3	√		
5.1.1.5	√		
5.1.2.1	√	√	
5.1.2.2	√		
5.1.2.3	√	√	
5.2.1.1	√	√	
5.2.1.3	√	√	
5.2.1.4	√		
7.8			√
7.9			√

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for each video transmitter and receiver pair is by Plan Quantity as may be revised by Adjusted Plan Quantity.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>VIDEO SYSTEM LINE UP AND TEST</u> - Item No.

Special Provision No. 683S07 September 2007

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1. SCOPE

This Special Provision covers the requirements for the system line up and test (SLAT) of all existing analog video links.

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

TIA/EIA-250-C Electrical Performance for Television Transmission Systems

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

Video Link: means baseband in (camera site) to baseband out (TOC) video communication link and shall include a Video Transmitter, Video Receiver, Video Multiplexer, Video Demultiplexer, interconnecting optical fibre, connectors and power supplies. A camera site consisting of digital video encoding equipment shall not be considered for video SLAT.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall provide a test procedure to the Contract Administrator describing all equipment and procedures for Video SLAT. The Contract Administrator's approval of the test procedure shall be obtained at least three weeks prior to the beginning of any Video SLAT.

5. MATERIALS – Not Used

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The Contractor shall perform quantitative testing on all existing analog video links and shall supply all test equipment required.

7.2 Video SLAT for any particular video link shall be performed after the associated camera has been installed and tested.

7.3 Each video link in the communication system shall be tested for qualitative performance with its associated camera turned on and connected to the BNC connector of the video link transmitter.

7.4 The Contractor shall perform all level adjustments and alignments required on the video link in order for it to operate in accordance with the Contract.

7.5 If any video link fails to meet the performance requirements as defined in the Contract then the Contractor shall take all steps necessary to restore the failed link to the required performance and the Contract Administrator may request the quantitative performance testing of any or all other video link(s) in the system.

7.6 The Contractor shall measure and record for each link the received optical power from the single or multi-channel Video Transmitter under test using a 90% APL flat field input at the optical connector to be coupled to the single or multi-channel Video Receiver under test.

7.7 The Contractor shall measure and record the baseband video output level from the Video Receiver.

7.8 The output video signal shall be connected to a monitor. The observed picture on the monitor shall be assessed for qualitative performance. All qualitative comments shall be recorded for each camera.

7.9 Each video link requiring quantitative performance testing shall be tested for the following performance characteristics:

a) Signal to Noise Ratio
b) Output Signal Level

7.10 All measurements shall conform to TIA/EIA-250-C for End-to-End Performance. Performance levels shall be in accordance with the Contract.

7.11 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including specifications, procurement, delivery, installation, testing, and the production of all drawings, text and test results in a format approved by the Contract Administrator.

WARRANT: Always with this item.

<u>FIBRE OPTIC MODEMS</u> - Item No.

Special Provision No. 683S09 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of fibre optic modems (FOM).

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

TIA/EIA-404-B Standard for Start-Stop Signal Quality for Non-Synchronous Data Terminal Equipment

EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the fibre optic modems to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Fibre Optic Modem

5.1.1 General

5.1.1.1 The FOM shall provide full duplex communication between two TIA/EIA-232-E data ports and shall allow a multidrop communications circuit to be formed using a pair of optical fibres as the transmission medium.

5.1.1.2 The FOM shall be configured as DCE.

5.1.1.3 The FOM shall be supplied with a cross connect device to permit communications between two DCE ports. The cross connect device may be internal to the FOM and selectable to provide DTE or DCE interface.

5.1.1.4 The FOM shall be configurable to operate in two modes designated as the repeater mode and the feeder mode. Selection of the operating mode shall be performed by means of a switch easily accessible without disassembly of the FOM.

5.1.1.5 A FOM which is to be electrically connected to a DCP or a PSD shall be cross connected to provide DCE to DCE interface and shall operate in the feeder mode.

5.1.1.6 A FOM which is to be electrically connected to a field controller or a Camera Control Receiver shall be configured to provide DTE to DCE interface and shall operate in the repeater mode.

5.1.1.7 Two FOMs interconnected by optical fibre shall provide full duplex communications on circuits BA and BB. The setting of circuit CA ON on either FOM shall result in circuit CF turning ON on the other FOM. Circuit identification shall be in accordance with TIA/EIA-232-E.

5.1.1.8 The FOM shall raise Clear to Send ON after it detects Request to Send ON.

5.1.1.9 The Contractor shall coordinate the Request to Send to Clear to Send delay with the DCP so as to minimize system data delay and to not lose any data. The Request to Send to Clear to Send delay shall not exceed 0.5 ms.

5.1.1.10 It shall be possible to interface two FOMs in the feeder mode through one or more FOM in the repeater mode.

5.1.1.11 All interconnections between FOMs shall be by multimode optical fibre.

5.1.1.12 A FOM shall have four optical ports (two transmitters and two receivers). Two of the ports (one transmitter and one receiver) shall be designated for upstream communication and two shall be designated for downstream communication.

5.1.1.13 When selected to operate in the repeater mode the FOM shall operate as follows:

a) All data information received through the upstream receiver shall be output on the TIA/EIA-232-E interface and shall be repeated through the downstream transmitter

b) When Request to Send is OFF on the FOM TIA/EIA-232-E interface, all data and control signal information received through the downstream receiver shall be repeated through the upstream transmitter

c) When Request to Send is ON on the FOM TIA/EIA-232-E interface, all data and control signal information received through the downstream receiver shall be inhibited and all data and control signal information received from the TIA/EIA-232-E interface shall be transmitted through the upstream transmitter

5.1.1.14 When selected to operate in the feeder mode the FOM shall operate as follows:

a) All data information received from the upstream and downstream receivers shall be output on the TIA/EIA-232-E interface.

b) All data information received from the TIA/EIA-232-E interface shall be output through the upstream and downstream transmitters.

5.1.1.15 Each FOM shall transmit information to another FOM through multimode optical fibre by means of a LED and all required bias circuitry.

5.1.1.16 LEDs shall transmit with a centre wavelength of between 820 nm and 870 nm at 25^{o} C. LEDs shall be coupled to optical fibre through an ST style compatible connector or panel mount receptacle mounted on the FOM.

5.1.1.17 The LED launch power shall be equal to or greater than 13 db greater than the receiver sensitivity.

5.1.1.18 The receiver shall be coupled to the optical fibre through an ST style compatible coupling or panel mount receptacle mounted on the FOM.

5.1.1.19 The receiver sensitivity shall be defined as the minimum optical power required to be received by the receiver to operate with a bit error rate of 10^{-9}.

5.1.1.20 Two FOMs interconnected by optical fibre with a total optical attenuation between 3 and 13 dB shall provide data communication between two TIA/EIA-232-E ports at a speed of 9600 baud with the created pulse width distortion not exceeding 1.5 µs.

5.1.1.21 Pulse width distortion shall be defined as the difference between the pulse width into one FOM TIA/EIA-232-E port and the output pulse width from the TIA/EIA-232-E port of an interconnected FOM. Pulse width shall be measured in units of time between the mark-to-space and space-to-mark transitions of any particular data bit measured in accordance with TIA/EIA- 404-B.

5.1.1.22 The FOM shall include all mounting hardware to mount it in an existing EIA standard 480 mm equipment rack supplied by the Ministry in each cabinet.

5.1.1.23 The FOM shall have a D-Type 25 pin connector providing an TIA/EIA-232-E compatible interface.

5.1.1.24 Pins 1, 2, 3, 4, 5, 6, 7, 8 and 20 shall be assigned in accordance with TIA/EIA-232-E. All other pins of the electrical interface shall not be connected.

5.1.1.25 LEDs shall be derated so that the peak optical power is emitted at least 3 dB below the power launched when driven at the maximum rated drive current.

5.1.1.26 The LED launch power shall be defined as the power launched by the LED into one metre of graded index optical fibre with a nominal core dimension of 62.5 µm, a nominal cladding dimension of 125 µm and a theoretical numerical aperture of 0.29.

5.1.1.27 Each FOM receiver shall receive information from the optical fibre by means of PIN photodiode and all required circuitry.

5.1.2 Power Supply

5.1.2.1 The FOM power supply shall meet the following requirements:

a) The power supply shall operate from an input voltage of 120 V 60 Hz nominal

b) The power supply shall have DC outputs rated to meet the voltage and current requirements of the FOM

c) Output current shall be protected against damage in the event of a short circuit

d) The power supply shall have a minimum Mean Time Between Failure of 50,000 hours

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 FOMs shall be installed in the cabinets identified in the drawings and shall share the available equipment space with existing equipment.

7.2 The drawings show the equipment space allocated to FOMs and PSDs for typical cabinet arrangements.

7.3 The Contractor shall coordinate the physical space required by the FOMs or PSDs required to be collocated to ensure that they will be accommodated in the allocated space.

7.4 The Contractor shall connect the FOM power supply to one of the 115VAC 60 HZ power distribution panel receptacles reserved for communication equipment.

7.5 Each FOM shall be configured as DCE or DTE and shall be selected to operate in repeater or feeder mode in accordance with the Contract.

7.6 The Contractor shall connect the correct Drop Cable connectors to each FOM in accordance with the drawings.

7.7 When connecting optical communication equipment, the Drop Cables shall be neatly trained along the rails of the equipment rack.

7.8 No Drop Cables shall be installed with a bending radius exceeding the manufacturer's minimum recommended bending radius.

7.9. Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT

CLAUSE	PIT	POP	SIT
5.1.1.1	√	√	
5.1.1.2	√		
5.1.1.3	√		
5.1.1.4	√		
5.1.1.5	√	√	√
5.1.1.6	√	√	√
5.1.1.7	√		
5.1.1.8	√		
5.1.1.9	√	√	√
5.1.1.10	√		
5.1.1.12	√		
5.1.1.13	√		
5.1.1.14	√		
5.1.1.17	√		
5.1.1.19	√ [1]	√ [2]	

Testing Footnotes:

1 All testing to be done at a bit error rate of 10^{-9}.

2 Test 2 fibre optic modems at a bit error rate of 10^{-9}, and the rest at 10^{-7}.

8. QUALITY ASSURANCE - Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of fibre optic modems is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except for SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>PORT SHARING DEVICES</u> - Item No.

Special Provision No. 683S10 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of the port sharing device (PSD).

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the port sharing devices to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 The PSD shall allow three separate TIA/EIA-232-E data ports of the PSD to share a common DCE TIA/EIA-232-E data port of the PSD. The PSD shall therefore have three separate ports and one shared port.

5.2 Each PSD shall be capable of transmitting and receiving 9600 bits per second to each of the data ports.

5.3 All connectors on the PSD shall be D-shell pin connectors.

5.4 The PSD shared port shall be cross-connected to provide DCE to DCE communications.

5.5 The three PSD separate ports shall be configured as DCE.

5.6 The PSD shared port will be connected to a DCP.

5.7 The three PSD separate ports will be connected to controllers, FOMs and other serial devices detailed in the Contract Drawings.

5.8 Pins on the D-Type connectors shall be assigned as per TIA/EIA-232-E.

5.9 The PSD shall support all required pins.

5.10 Circuits BA (Transmit) on each of the three separate ports shall be isolated from each other.

5.11 All data present on circuit BA of any separate port shall be present on circuit BA of the shared port.

5.12 All data received on circuit BB of the shared port shall be present on circuit BB of each of the three separate ports.

5.13 Circuits CA (Request to Send) on each of the three separate ports shall be isolated from each other.

5.14 Request to Send (circuit CA) received on any separate port shall be present on circuit CA of the shared port and circuit CB (Clear to Send) of the Request to Send originating separate port. Clear to Send (circuit CB) received by the shared port shall not be present on circuit CB of any separate port.

5.15 Received Line Signal Detector (circuit CF) received by the shared port shall be present on circuit CF of each separate port.

5.16 The PSD shall support full duplex communication.

5.17 The PSD shall be a passive device not requiring external power.

5.18 The PSD shall include all mounting hardware required to securely mount the PSD in the EIA 480 mm equipment rack.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 PSDs shall be installed in the equipment cabinets identified in the drawings and shall share the available equipment space with existing equipment.

7.2 The drawings show the configuration of existing equipment supplied by the Ministry and the equipment space allocated to PSDs and FOMs for typical cabinet arrangements.

7.3 The Contractor shall co-ordinate the physical space required by the PSD with the FOMs required to be collocated with the PSD.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT

CLAUSE	PIT	POP	SIT
5.1	√	√	
5.2	√	√	

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of port sharing devices is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing, and the production of all drawings, text and test results.

WARRANT: Always with this item.

<u>DATA SYSTEM LINEUP AND TEST</u> - Item No.

Special Provision No. 683S11 September 2007

1. SCOPE

This Special Provision covers the requirements for the line up and test of the data system. The activities shall include verification of all data circuits, data links, primary and redundant networks, and the integrated data system. This Special Provision details required testing for legacy, Ethernet, and serial over IP communication systems.

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

TIA/EIA-404-B Standard for Start-Stop Signal Quality for Non-Synchronous Data Terminal Equipment

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

DSLAT: means Data System Lineup and Test

LB: means Loop Back

SLAT: means System Lineup And Test

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

4.1.1 The Contractor shall provide a test procedure to the Contract Administrator describing all equipment and procedures for Data SLAT. The Contract Administrator’s approval of the test procedure shall be obtained at least three weeks prior to the beginning of any Data SLAT.

4.1.2 The Contractor shall provide a line diagram representing any testing setup that will be performed.

5. MATERIALS

5.1 A Loop Back (LB) connector shall be used to provide data loop back on all serial data circuits and data links. The LB connector shall be the appropriate size, gender and configuration to be capable of allowing the remote testing of both transmit and receive data circuits and all applicable hardware and/or software flow control signals.

5.2 Other testing kits and materials, as required, shall be used to complete the tests outlined below.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Legacy Communication Equipment

7.1.1 The Contractor shall perform the following tests as well as any other tests the Contract Administrator deems necessary. The tests shall be performed on both the primary and redundant networks. Testing shall be performed with various standard data rates up to 19.2 kbps as specified by the Contract Administrator. Burst and continuous data flow shall be used during testing.

7.1.2 The Contractor shall perform all level adjustments required for the data system to operate in accordance with the Contract.

7.1.3 Data SLAT shall occur in three stages.

7.1.4 The first stage may begin after all low speed data devices (FOMs, optical splitters, optical taps and PSDs) and the interconnecting fibre optic links have been installed at a Node. Tests shall be carried out with all modems connected to the optical bus and powered on.

7.1.5 Stages two and three shall begin after all data communication equipment associated with a Data Ring Network has been installed. Stages two and three shall be performed with all Nodes in the Data Ring Network under test powered ON.

7.1.6 Stages two and three shall be performed on at each FDIN and the CDIN.

7.1.7 Each Node shall be demonstrated to be compliant with the specifications.

7.1.8 RTS/CTS signalling shall be used between the multiplexer and the collocated modem to verify correct signal handshaking.

7.1.9 The Contractor shall perform testing of the LCP to demonstrate compliance with the specified performance. The Contractor shall submit a test methodology, which should include detailed procedures including but not limited to demonstrating multiple segment operation, data throughput and propagation delay. The Contractor shall supply all equipment and software required to conduct the testing.

7.1.10 Stage One

7.1.10.1 The first stage shall be the SLAT of all low speed data circuit components including all FOMs, optical splitters, optical taps and PSDs. Stage one shall not commence until all items, which comprise of the low speed data link have passed their respective proof of performance testing.

7.1.10.2 Stage one SLAT shall verify the correct operation of each low speed data circuit between FOM EIA/TIA-232-E interfaces at field controllers and Camera Control Receivers and FOM and PSD EIA/TIA-232-E interfaces at FDINs. It shall verify proper operation of all interconnecting devices in each circuit by the presence of data and correct control signals.

7.1.10.3 The Contractor shall connect the LB connector to the FOM or PSD being tested starting at the EIA/TIA-232-E port of the low speed data device closest to the DCP under test. The device to which the LB connector is attached is the device which is being tested.

7.1.10.4 The Contractor shall connect a test device which shall input a standard test signal compatible with EIA/TIA-232-E into the correct pin of the EIA/TIA-232-E port of the final device at the point where the FDIN DCP will be connected.

7.1.10.5 The test signal shall be turned ON. The following parameters shall be verified:

7.1.10.6 Circuit CA is in the ON state and present on the correct pin.

7.1.10.7 Test signal is correctly received at the test device on circuit BA at the correct signal level and on the correct pin.

7.1.10.8 When circuit CA is in the OFF state, circuit CF is in the OFF state and when CA changes to the ON state, CF changes to the ON state within 7.2 msec.

7.1.10.9 When circuit CA is in the OFF state, the modem LED and data are in the OFF state and when CA is in the ON state, data is received correctly.

7.1.11 Stage Two

7.1.11.1 The second stage SLAT shall demonstrate correct circuit assignment between DCPs at FDINs and the corresponding CDIN DCP. Stage two shall not commence until all drop / insert nodes and data channel ports have passed proof of performance testing.

7.1.11.2 The Contractor shall verify the correct circuit assignments of each DCP in the Data Ring Network.

7.1.11.3 The Contractor shall set the FDIN DCP to be tested into the loopback mode. All other FDIN DCPs shall not be in loopback.

7.1.11.4 The Contractor shall connect a test device which shall input a standard test signal compatible with EIA/TIA-232-E into the correct pin of the CDIN DCP being tested.

7.1.11.5 The Contractor shall turn the signal generator ON. The following parameters shall be verified:

a) Test signal is correctly received at the test device on circuit BB at the correct signal level and on the correct pin;

b) Circuit CF is ON at the correct signal level and on the correct pin.

7.1.12 Stage Three

7.1.12.1 The third stage shall be the SLAT at each Node of two end-to-end data circuits as they shall be connected in the operating data system. Stage three shall not commence until stages one and two of Data SLAT have passed in their entirety.

7.1.12.2 The Contractor shall attach the LB connector to the EIA/TIA-232-E port of the low speed device being tested. In this test the field device may be a FOM, PSD or DCP. Two end-to-end data circuits passing through a DCP at each FDIN shall be tested. The Contract Administrator will designate the circuits to be tested prior to the test.

7.1.12.3 The Contractor shall connect a test device which shall input a standard test signal compatible with EIA/TIA-232-E into the correct pin of the CDIN DCP interface being tested.

7.1.12.4 The Contractor shall measure the gross start stop distortion of the test signal received at the field device under test.

7.1.12.5 After the data circuit is tested in one direction the Contractor shall input a standard test signal into the field devices tested above and shall measure the gross start stop distortion at the CDIN DCP.

7.1.12.6 The Contractor shall measure the following performance characteristics on end-to-end circuits:

7.1.12.7 Gross start stop data distortion shall not exceed 20% measured as per TIA/EIA-404-B.

7.1.12.8 While the test signal is being received during one of the stage three tests the Contractor shall disconnect one of the Data Ring Network optical fibres to the FDIN under test and shall record compliance or non-compliance with the following:

a) End-to-end data communication stops after the fibre is disconnected;

b) End-to-end data communication is restored after not more than 3 seconds per node.

7.1.12.9 The Data Ring Network optical fibre shall be reconnected to the Node. The Data Ring Network shall be reset from the CDIN and verified to have reconfigured to normal operation.

7.2 Ethernet Communication Equipment

7.2.1 The Contractor shall verify all Ethernet switch power status, link integrity on each electrical/optical port, and data activity on each electrical/optical port.

7.2.2 The Contractor shall verify redundancy of the network. The Contractor shall disconnect each switch, one at a time, and confirm no network data packet loss and no network link loss to and from all connected switches via redundant path(s).

7.2.3 The Contractor shall verify that any Ethernet switch shall be able to restore network services if any optical path is broken.

7.2.4 The Contractor shall confirm required network management diagnostics, monitoring, alarm, logging and configuration features.

7.3 Serial Over IP/Port Server Equipment

7.3.1 The Contractor shall verify all port server power status, link integrity on each electrical/optical port, and data activity on each electrical/optical port.

7.3.2 The port server shall have a packet error rate (Ethernet interface) and bit error rate (serial interface) of at least 10^{-6} when transmitting serial data at 9600 baud.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT – Not Used

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including the production of all drawings, text and test results.

WARRANT: Always with this item.

DROP / INSERT NODES - Item No.
CHANNEL PORTS - Item No.

Special Provision No. 683S19 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of Field Drop and insert nodes (FDINs), Central Drop and insert nodes (CDINs), data channel ports (DCPs), LAN channel ports (LCPs) and fibre optic Ethernet hubs (FOEHs), which shall be interconnected to form a data ring network. The CDINs and FDINs shall be used only for replacement of existing equipment.

The CDINs and FDINs shall operate in a drop and insert ring topology with the ability to provide multi-drop operation to terminal equipment utilizing the DCPs and LCPs to connect to the low speed distribution circuits.

Data channel ports and LAN channel ports will be referred to as channel ports when distinction between the two is not required.

FDINs and CDINs will be referred to as nodes when distinction between the two is not required.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange
EIA-310-D	Cabinets, Racks, Panels and Associated Equipment

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005	IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications
Military Handbook	MIL-HDBK 217C
AT&T publication	1P1045, Method V

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

FOEH: means Fibre Optic Ethernet Hubs.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit the specification sheets for the drop/insert nodes and channel ports to the Contractor Administrator for review prior to ordering.

5. MATERIALS

5.1 Drop / Insert Node

5.1.1 General

5.1.1.1 Each component shall be permanently marked to identify the model number and unique serial number of the component.

5.1.1.2 The FDIN and CDIN shall consist of one or more mainframe card cages in which all components shall be housed. The cages(s) shall not exceed the total envelope reserved for this equipment in the cabinets as specified in Section 5.1.5.

5.1.1.3 All electronic components shall be mounted on PC boards in accordance with the Contract.

5.1.1.4 Each component described below may be mounted on one or more PC board(s). In addition, one PC board may support the function of two or more components or the partial function of a component with the exception of the power supply which shall be mounted on a separate PC board or boards.

5.1.1.5 All memory devices required to restore operation of the Data Ring Network in the event of a power blackout or power supply failure shall be nonvolatile and shall maintain all data in memory.

5.1.1.6 All components shall be interchangeable between FDINs and CDINs. Set up of a component prior to installation in a FDIN or CDIN shall be by means of DIP switches or software controlled configuration. It shall be possible to add or change FDIN and CDIN components without the need for any adjustments.

5.1.1.7 Alarm indicators shall be provided to indicate individual failure of any redundant components.

5.1.1.8 The nodes shall communicate in a ring fashion with up to 32 nodes in a logical network. The primary link is defined as an optical path around the ring supporting communications under “normal” operation. The secondary link is defined as a separate path around the ring that is utilized upon system faults. Upon an optical or node failure the nodes shall automatically reconfigure to maximize the number of FDINs connected to the CDIN utilizing both primary and secondary links.

5.1.1.9 Each node shall be expandable to support not less than 20 DCPs and 2 LCPs.

5.1.1.10 The data nodes shall be capable of supporting T-1 data channel cards.

5.1.2 Optical Interface Equipment

5.1.2.1 A FDIN and CDIN shall have two optical interface equipment (OIE) units.

5.1.2.2 The OIE shall operate at the SONET OC-3 rate and shall use SONET OC-3 framing.

5.1.2.3 The OIE shall input and output electrical signals to and from the Common Control Logic and convert them as required to be transmitted into or received from an optical fibre.

5.1.2.4 An OIE shall consist of a transmitter and a receiver.

5.1.2.5 One OIE shall be designated as the primary transmitter and receiver.

5.1.2.6 One OIE shall be designated as the secondary transmitter and receiver.

5.1.2.7 The transmitter shall consist of a laser connected to an FC-PC or SC style compatible coupling or panel mount receptacle mounted on the OIE.

5.1.2.8 The transmitter shall emit at a centre wavelength, nominally at 1310 nm at 25^{o}C.

5.1.2.9 The transmitter launch power shall be defined as the optical power launched by the transmitter into one metre of single mode optical fibre with a nominal core diameter of 8.5 µm, and a cladding dimension of 125 µm.

5.1.2.10 The receiver sensitivity shall be defined as the minimum optical power required to be received by the receiver to operate with a bit error rate of $10E^{-9}$.

5.1.2.11 The transmitter launch power shall be at least 12 dB greater than the receiver sensitivity.

5.1.2.12 The receiver shall use either a PIN photodiode or an avalanche photodiode connected to an FC-PC or SC style compatible connector or panel mount receptacle mounted on the OIE.

5.1.2.13 The receiver shall include all circuitry necessary to convert an optical signal to an electrical signal for input into the switch.

5.1.2.14 The receiver shall operate at the same wavelength window as the transmitter.

5.1.2.15 The receiver shall allow direct connection to the transmitter by an optical patchcord and shall meet all performance specifications within its dynamic range.

5.1.3 Common Control Logic

5.1.3.1 The Common Control Logic shall detect primary and secondary link failures in accordance with the Contract.

5.1.3.2 The Common Control Logic shall route the aggregate channel as defined under Section 5.1.7 Performance.

5.1.3.3 The FDIN shall transmit its current operating status to the CDIN.

5.1.3.4 The FDIN shall transmit an alarm upon the failure of any redundant component and any channel card to the CDIN.

5.1.3.5 The common control logic shall make the aggregate channel available to channel ports so that the preselected time slots are dropped at their physical interface.

5.1.3.6 The common control logic shall receive data to be inserted onto the aggregate channel from channel ports and shall insert the data onto the aggregate channel in the preselected time slot.

5.1.3.7 The common control logic shall allow the preselection of a time slot such that it can be dropped at each data node in the ring (multidrop operation) for both DCPs and LCPs. DCPs only can alternately be multidropped using separate time slots and a modem sharing device at the CDIN, which shall be provided as part of the CDIN. The Contractor shall provide this multidrop operation in a manner that uses the minimum aggregate bandwidth possible.

5.1.3.8 The common control logic shall route the aggregate channel to the channel ports in such a manner that the failure of any channel port or the physical removal of any one or all channel ports shall not affect the aggregate channel. The aggregate channel shall have a complete route through the node bypassing the channel ports.

5.1.4 Power Supply

5.1.4.1 The power supply shall operate from a 115 VAC ±10%, 60 Hz ±3 Hz source.

5.1.4.2 The power supply shall provide all power required by the FDIN or CDIN.

5.1.4.3 The power supply shall be provided in a redundant configuration and shall allow replacement of either supply without powering down the node.

5.1.4.4 The power supply shall be connected to the power distribution assembly in the cabinet and as directed by the Contract Administrator.

5.1.5 Mainframe

5.1.5.1 The mainframe shall physically support all FDIN and CDIN PC boards.

5.1.5.2 The mainframe shall provide all required interconnections between PC boards.

5.1.5.3 All PC boards shall be held in place by a locking mechanism which shall prevent PC board loosening by vibration.

5.1.5.5 PC boards shall be easily removed from the mainframe without the requirement for any special tools.

5.1.5.6 The mainframe shall be designed to fit in an EIA standard 480 mm rack.

5.1.5.7 The mainframe envelope shall not require more than 350 mm of vertical rack space, and shall not require more than 480 mm of depth, including cables.

5.1.5.8 The mainframe shall be constructed of anodized aluminum.

5.1.6 LED Indicators

5.1.6.1 Each node shall have the following front panel LED indicators:

a) Primary Link Alarm
b) Secondary Link Alarm
c) Primary Low Signal
d) Secondary Low Signal
e) AC Power

5.1.7 Performance

5.1.7.1 The propagation delay between a CDIN DCP and any other DCP on the same time slot in the ring shall be not greater than 40 ms plus one character time. The fibre delay portion shall be based on a ring circumference of 88 km.

5.1.7.2 The propagation delay between any 2 LCPs on the same time slot(s) in the ring shall be not greater than 30 ms, using a packet size of 500 octets.

5.1.7.3 The Nodes shall reconfigure in the event of a fibre or node fault such that data communications between any two nodes is not interrupted for more than 1 second in a 32 node system.

5.1.7.4 The Mean Time Between Failure (MTBF) of a FDIN or CDIN shall be greater than or equal to 30,000 hours for failures resulting in the loss of communication between a FDIN channel port and the CDIN channel port.

5.1.7.5 The Contractor shall provide the MTBF of each module supplied in the system or subsystem.

5.1.7.6 The MTBF analysis shall be based on FDIN and CDIN historical data or the methods contained in MIL-HDBK 217C or other validated sources of data such as AT&T publication 1P1045, Method V. A ground fixed environment shall be used.

5.2 Data Channel Port

5.2.1 The data channel port (DCP) shall be mountable in either a FDIN or CDIN mainframe.

5.2.2 The DCP shall consist of a data port for connection to devices external to the Node and all circuitry required to interface the data port with the selected time slot of the aggregate channel.

5.2.3 All DCP active components shall be mounted on a PC board.

5.2.4 Up to four DCPs may reside on a common PC board.

5.2.5 The data port shall be TIA-232-E compatible and shall be configured as DCE.

5.2.6 The DCP shall support the following functions: transmit data (TD), receive data (RD), Request to Send (RTS), Clear to Send (CTS) and ground (GND). The Contractor shall clearly identify how the equipment supports the handshaking control lines.

5.2.7 The delay between receiving ‘request to send’ ON and raising ‘clear to send’ ON shall be not more than 10 ms.

5.2.8 A DCP shall be capable of being field preselected to transmit and receive on any timeslot.

5.2.9 The DCP shall be designed to continuously transmit and receive full duplex asynchronous data at 1200 to 19,200 b/s.

5.2.10 The DCP shall transmit and receive asynchronous characters with one start bit, 8 or 9 information bits and stop bits of 1 or 2 bits duration.

5.2.11 When the DCP receives a ‘request to send’, all data received on the data port shall be inserted onto the selected time slot.

5.2.12 If ‘request to send’ is not present, the DCP shall not insert any received data from the TIA-232-C port onto the selected time slot but shall leave all existing data on that time slot unaffected.

5.2.13 Preselection of time slots to be assigned to a DCP shall be by software assignment from a terminal temporarily connected to the FDIN and computer permanently connected to the CDIN. It shall be possible to reassign a DCP to any time slot(s).

5.2.14 The DCP data connector shall be easily accessed from either the front or rear of the node.

5.3 LAN Channel Port

5.3.1 The LAN channel port (LCP) shall be mountable in either a FDIN or CDIN mainframe.

5.3.2 The LCP shall provide an IEEE802.3/Ethernet LAN port for connection to devices external to the Node and all circuitry required to interface the LAN port with the selected time slot(s) of the aggregate channel.

5.3.4 The LCP shall provide a 10BaseT RJ-45 connection.

5.3.5 All LCPs sharing the same time slot(s) of the aggregate shall operate such that a packet entering a node’s LCP shall appear at destination node’s LCP.

5.3.6 The LCP shall incorporate a data buffer and detection mechanisms to avoid data loss due to existing traffic, both on the aggregate and on the local segment.

5.3.7 The LCP shall provide aggregate throughputs ranging from 1.5 Mb/s to at least 10 Mb/s.

5.3.8 The LCP shall provide front panel LEDs indicating data transmission and collisions on the local segment.

5.3.9 All LCP active components shall be mounted on a PC board.

5.4 Network Management System

5.4.1 An integrated network management system is required for the communications network.

5.4.2 The network management system shall include all the hardware (computer, printer, cables, etc.) and software necessary to configure, control, and maintain all data nodes in the data communications subsystem.

5.4.3 The software shall be DOS, Windows or UNIX based.

5.4.4 The software shall be an integrated, user-friendly application.

5.4.5 Each node shall also contain network management intelligence such that an ASCII terminal connected to any node is capable of monitoring and controlling the node.

5.4.6 The network management system shall be capable of controlling/monitoring not less than 60 FDINs from the CDIN location, located on 4 separate rings. The hardware and software shall support the connection of a remote computer by modem to provide a second control location.

5.4.7 All alarms and diagnostic reports shall be provided in an ASCII character based serial format for integration with the Owner's central computer system software. Node status and current alarm list shall be transmitted in either one of two formats:

a) The Owner's central computer system will poll for status with a response from the Network Management System, or

b) The Network Management System will broadcast the data every two minutes to the Owner's central computer.

5.4.8 The Contractor shall provide the protocol message format and details to allow integration with the Owner's central computer.

5.4.9 Alarms shall be reported such that inconsequential alarms (such as those occurring as a result of ring reconfiguration) are suppressed, in order to avoid "burying" actual equipment alarms in excessive less important information.

5.4.10 Any single failure shall not result in the loss of communications with more than one node. Upon removal of the fault condition, the network management system shall automatically restore normal operation or attempt to maximize the number of nodes connected in the ring.

5.4.11 The network management system shall not permit oscillation between states in the event of an intermittent failure.

5.4.12 Cabling shall meet fire safety ratings where applicable.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 CDINs shall be installed in the TOC cabinet at the location shown on the drawings.

7.2 FDINs shall be installed in cabinets identified in the drawings and shall share the available equipment space with existing equipment. FDINs shall be installed in cabinets within the designated areas on the drawings.

7.3 The drawings include the equipment space allocated to FDIN and related equipment for typical cabinet arrangements. The Contractor shall coordinate the physical space required by the FDIN and related equipment with the allocated space.

7.4 The Contractor shall install the correct number of required DCPs, LCPs and FOEH ports at each Node in accordance with the requirements of the Contract.

7.5 The Contractor shall connect the Node and FOEH power supply cord to the power distribution assembly receptacles reserved for communication equipment.

7.6 The Contractor shall connect the proper fibre optic connectors to each node and FOEH to configure the communication links between each device in accordance with the Contract.

7.7 All fibre optic links connected to a node shall have been tested and verified in accordance with the Contract prior to node installation.

7.8 Data interface cables shall be designed and installed such that any necessary control lead signalling is passed between the FDIN and the connected controller, e.g. if FDIN DCP multi-drop access requires control leads for proper operation, the data interface cables shall be integrated with the fibre optic modems such that the ATC can manage the control leads properly.

7.9 The Contractor shall neatly train drop cables, LAN cables and data interface cables together when routing them along the same path and shall neatly train them along the support rails of equipment racks. The Contractor shall not interfere with or disturb existing cables.

7.10 No cables shall be installed with a radius less than the manufacturer's minimum recommended bending radius.

7.11 The Contract Administrator will inform the Contractor which time slots are to be assigned to each DCP and LCP prior to functional testing.

7.12 The Contractor shall verify that the drop / insert nodes perform to the specified standards when used in operation with controllers, fibre optic Ethernet hubs (FOEHs), modems, fibre optic cables, central computer, and other components or systems installed in the Contract.

7.13 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.7	√	√	
5.1.1.8 [1,2]	√	√	√
5.1.2.2	√		
5.1.2.8	√		

CLAUSE	PIT	POP	SIT
5.1.3.4	√	√	
5.1.4.3	√		
5.1.6.1	√		
5.1.7.3	√	√	
5.2.6	√		
5.2.9	√		
5.3.7	√		
5.3.8	√		
5.4.7		√	√
7.12			√

Testing Footnotes:

[1] Each node shall be powered down individually. While a node is powered down the data ring network shall be verified to have reconfigured in accordance with the Contract. The network management system shall correctly identify the powered down node. After reconfiguration the powered down node shall be powered up. The data ring network shall be verified to have returned to normal operation.

[2] Each primary and secondary link in the data ring network shall be inhibited by removal of an appropriate link. The data ring network shall be verified to have reconfigured in accordance with the Contract and all end-to-end data communication shall resume. The network management system shall correctly identify the inhibited link. After reconfiguration the inhibited link shall be restored. The data ring network shall be verified to have returned to normal operation.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of drop/insert nodes and channel ports is by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender items shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of all drawings, text and test results, software revisions and hardware improvements except SIT which is paid for under a separate item.

WARRANT: Always with these items.

<u>LEASED LINE MODEMS</u> - Item No.

Special Provision No. 683S21 September 2007

1. SCOPE

This Special Provision covers the requirements for the supply and installation of leased line modems.

2. REFERENCES

This Special Provision refers to the following standards, specifications, or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange

EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

PVC: means Polyvinyl Chloride.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the leased line modems to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 The modems shall have a bit error rate of at least 10^{-9} when operating at 9600 bps.

5.2 Modems shall be EIA/TIA-232-E compatible, and operate at speeds up to 9600 bps, asynchronous.

5.3 Modems shall be suitable for operation in a half-duplex, service provider configured, point-to-multipoint or point-to-point leased line environment, as shown in the Contract Drawings.

5.4 Modems shall support all required pins defined in EIA/TIA-232-E.

5.5 The modems shall include all mounting hardware required for mounting in an EIA 480 mm equipment rack.

5.6 The modems shall be supplied with a D-type 25 pin connector compatible with EIA/TIA-232-E, and shall be configured as DCE.

5.7 Modems shall meet this specification over an operating temperature range of – 10^{o} C to + 40^{o} C. Modems shall be supplied to operate from 115 ±15% VAC, 60Hz ±5%.

5.8 Modems shall be supplied with all cables required to connect to both the Service Provider demarcation point and the Advanced Traffic Controller (ATC).

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The leased lines will be used to transmit data between field sites and the TOC. The Contractor shall install modems at locations shown in the Contract Drawings.

7.2 The Contractor shall install all required data interface cables required to connect the EIA/TIA-232 ports of the leased line modems to the ATC in the field.

7.3 Data cables shall meet the following requirements:

a) The cable shall contain 7 shielded twisted pairs of insulated 24 AWG stranded tinned copper conductors. Conductors shall be colour coded.

b) Insulation shall be datalene insulated and the jacket shall be constructed of PVC.

c) The shield shall consist of an overall aluminium-polyester shield and an overall tinned copper braid shield.

d) A 24 AWG stranded tinned copper drain wire shall be provided.

e) Connectors shall have a metallic shield and shall be capable of fastening to the mating device such that pulling of the cable or connector does not result in the loss of connection. The connector shall be supplied with solderless, gold-plated pins or receptacles which shall be capable of being relocated in the connector housing.

7.4 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1	√ [1]	√ [2]	
5.2	√		
7.1		√	√

<u>Testing Footnotes:</u>

[1] All testing to be done at a bit error rate of 10^{-9}.

[2] Test 2 leased line telephone modems at a bit error rate of 10^{-9}, and the rest at 10^{-7}.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of each leased line modem is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measure is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including supply, installation, testing and the production of documentation and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

WIRELESS ETHERNET BRIDGES – Item No.

Special Provision No. 683S22 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of wireless Ethernet bridges. The wireless Ethernet bridge shall provide a point-to-point network connection where a fibre optic link does not exist. This item shall include an antenna, radio, network interface, cabling, power supply, and all necessary mounting equipment.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA-195C Electrical and Mechanical Characteristics for Microwave Antennas

TIA-222-D Structural Standard for Antenna Supporting Structures and Antennas

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005 IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Others:

IC RSS 210 Industry Canada Radio Standards Specification Low-power Licence Exempt Radiocommunication Devices

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Category 5 cable: means a twisted pair cable type designed for high signal integrity. This type of cable is used for computer networks such as Ethernet, and is also used to carry many other signals such as basic voice services, token ring, etc.

ISM: means Industrial, Scientific, and Medical radio bands.

Latency: means the delay between the initiation of a network transmission by a sender and the initial receipt of that transmission by a receiver. It is typically commensurate with the distance the signal must travel, but is also affected by delays introduced in network routing, including queues, multiple routes, packet loss, etc.

SNMP: means Simple Network Management Protocol.

WPA: means Wi-Fi Protected Access.

VSWR: means Voltage Standing Wave Radio

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the wireless Ethernet bridges to the Contract Administrator for review prior to ordering. The submission shall include all information and documentation needed in order to verify Industry Canada approvals.

5. MATERIALS

5.1 General

5.1.1 The wireless Ethernet bridge shall operate in the any Industry Canada license exempt band.

5.1.2 The units shall have a minimum of 4 separate non-overlapping frequency channels. These channels shall be user selectable.

5.1.3 The units shall meet safety compliance with CSA (C-UL), and CEC.

5.1.4 The units shall be compliant with most recent version of Industry Canada RSS-210.

5.1.5 The wireless Ethernet bridge shall not cause interference that disrupt the operation of other wireless equipment nor accept interference that may cause undesired operation of the device.

5.1.6 The wireless Ethernet bridge shall include all mounting hardware necessary for mounting on poles.

5.1.7 All Ethernet interfaces shall comply with IEEE 802.3 specifications.

5.1.8 The wireless Ethernet bridge shall include a minimum of one (1) auto negotiable 10/100BaseTX electrical port.

5.1.9 All Ethernet connectors shall be RJ-45 connectors.

5.1.10 The wireless Ethernet bridge shall include device management software to allow for remote configuration and fault diagnostics using SNMP. All required licenses shall be included in the Contract price for the item.

5.1.11 The materials supplied shall include any filters, couplers, or attenuators required to meet the performance requirements.

5.1.12 All wireless Ethernet bridge components shall be adequately protected against corrosion and other damaging influences of the roadside conditions.

5.1.13 The receiver sensitivity shall be -85 dBm or better.

5.2 Electrical

5.2.1 The wireless Ethernet bridge shall retain operational parameters during a power interruption and shall automatically resume normal operation after the power is restored.

5.2.2 The units shall accept power from a 115 VAC ± 15%, 60 Hz ± 5% receptacle.

5.2.3 The Contractor shall provide power supplies required for full operation of the wireless Ethernet bridge.

5.2.4 All power supplies shall be CSA approved and installed in accordance with Ontario Electrical Safety Code regulations.

5.3 Performance

5.3.1 The wireless Ethernet bridge shall have a minimum unidirectional throughput of 20 Mbps.

5.3.2 The units shall be capable of operating over a minimum range of 5 km line of sight.

5.3.3 The wireless Ethernet bridge system latency shall not exceed 5 ms.

5.3.4 The units shall have a packet error rate of 10^{-6} or better at -85 dBm.

5.4 Security

5.4.1 Address filtering shall be done in the MAC layer and not in any layer from the Network Layer and above.

5.4.2 The security protocol for the wireless Ethernet bridges shall be WPA or proprietary.

5.5 Antenna

5.5.1 The Contractor shall provide all necessary mounting hardware to mount the antenna (or integrated Tx/Rx unit) to the poles indicated in the Contract Drawings.

5.5.2 The signal strength emitted from the antenna shall not exceed the most recent issue of IC RSS-210, antenna emission standards.

5.5.3 The antenna shall operate with the transmitter and receiver operating frequencies in the ISM band.

5.5.4 The antennae shall conform to EIA-195C (Electrical and Mechanical Characteristics for Microwave Antennae).

5.5.5 The maximum azimuth and elevation beamwidth of the antenna shall be no greater than 20^o.

5.5.6 The antenna’s azimuth and elevation beamwidth and gain shall be procured so that the wireless Ethernet bridge achieves its performance specifications.

5.5.7 If an external antenna is needed for the application, it shall be provided by the supplier of the wireless device. Any antenna modifications shall comply with Industry Canada regulations for this product.

5.5.8 A protective radome shall be supplied with each antenna to prevent any surface icing and shield the antenna from ice, snow, dirt, and salt.

5.5.9 The antenna connector shall be N-Type female.

5.5.10 The antenna input impedance shall be 50 ohms.

5.6 Physical

5.6.1 All wireless Ethernet bridge components shall have an operating temperature range of at least – 40^{o} C to + 60^{o} C with a relative humidity of 95% non-condensing.

5.6.2 The wireless Ethernet bridge shall be capable of storage without damage in an unpowered state over a temperature range of – 50^{o} C to + 85^{o} C.

5.6.3 The wireless Ethernet bridge antenna (or integrated Tx/Rx unit) mounted on the CCTV camera poles shall not exceed a physical weight of 5 kg.

5.6.4 The wireless Ethernet bridge shall be able to withstand a wind load of at least 160 km/h.

5.6.5 The units shall be either hermetically sealed or shall be equipped with a removable drain plug to avoid the collection of moisture inside the unit.

5.7 Cabling

5.7.1 The Contractor shall supply all necessary cabling required to make the wireless Ethernet bridge operational.

5.7.2 Cables shall run continuous from the controller cabinet to the antenna (or integrated Tx/Rx unit). No intermediate splices shall be allowed.

5.7.3 Ethernet cables shall be outdoor rated Category 5 (CAT5) or better.

5.7.4 The distance of any Ethernet cable shall not exceed 50m.

5.7.5 The coaxial cable, if required, shall be 12.7mm foam dielectric type or equivalent. The outer conductor of the coaxial cable shall be solid corrugated or braided copper and shall provide continuous shielding against radio frequency and electromagnetic interference. The dielectric of the coaxial cable shall be polyethylene foam with no pressurization required. The impedance of the coaxial cable shall be 50 ohms.

5.7.6 The outer jacket of any type of cable to be connected to the antenna shall be weatherproof and ultraviolet stabilized for outdoor applications.

5.8 Surge Protector

5.8.1 The surge protector shall be of dc blocked, multi-strike type or an approved equivalent.

5.8.2 The surge protector shall be housed in the control cabinet and connected to the electrical system ground, or alternatively to a dedicated ground electrode provided for protection of the pole mounted systems.

5.8.3 For coaxial cabling, the surge protector shall have the following characteristics:

a)	Impedance:	50 ohms
b)	Maximum power:	50W
c)	VSWR:	< 1.1 over ISM band
d)	Insertion loss:	< 0.1 dB over ISM band

5.8.4 For all cabling to the antenna (or integrated Tx/Rx unit) the surge protector shall have the following characteristics:

a)	Maximum Surge:	50 kA IEC 801-5 8/20 waveform 500J
b)	Strike throughput energy:	< 220 µJ
c)	Turn-on voltage:	600V DC ±20%
d)	Turn-on time:	2.5 ns for 2 kV/ns

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation and Configuration

7.1.1 The wireless Ethernet bridge shall be installed according to the manufacturer's recommendations.

7.1.2 The wireless Ethernet bridge power cables shall be connected to the uninterruptible power supply in the cabinet.

7.1.3 The wireless Ethernet bridge shall be aligned to optimize the transmitted signal.

7.1.4 The equipment shall be properly grounded for lightning protection in accordance with EIA-195C.

7.1.5 The Contractor shall install the surge protectors in accordance to the manufacturer's recommendations.

7.1.6 The surge protectors shall be installed at each location and shall be suitably grounded.

7.1.7 The coaxial cable between the antenna and transmitter and shall be routed within conduit.

7.1.8 The Contractor shall terminate all cables with the appropriate connectors to terminal equipment to provide a fully functional system. The Contractor shall seal all connectors against moisture after tightening.

7.1.9 The Contractor shall ground all cable runs to the manufacturer's recommendations.

7.1.10 The Contractor shall neatly train and organize all cables. No cables shall be installed with a radius less than the manufacturer's minimum recommended bending radius. All cables shall be labelled.

7.1.11 The wireless Ethernet bridge supporting structure shall be securely fastened to the vertical component of any static structure. No welding or drilling of the structure is permitted. The antenna shall be mounted in such a manner as not to interfere with any other component or any normal maintenance activity.

7.1.12 The devices shall be mounted in a manner that allows easy access to all connections.

7.1.13 The mounting and grounding arrangement shall meet or exceed the recommendations as stipulated in TIA-222-D.

7.1.14 The Contractor shall mount the units to minimize the hazard of rainwater entering the assembly.

7.1.15 In the event that out-of-band noise interferes with the operation of the wireless Ethernet bridge, the Contractor shall install a supplemental bandpass filter.

7.1.16 The Contractor shall install all interface cable connections between the wireless Ethernet bridge and Ethernet switches according to the drawing package.

7.1.17 The Contractor shall configure an IP address for the wireless Ethernet bridges based on the information provided by the Contract Administrator.

7.1.18 The Contractor shall configure all user names and passwords for the wireless Ethernet bridge based on the information provided by the Contract Administrator.

7.1.19 All cables shall be trained together along the support rails in the equipment racks.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.2	√	√	
5.1.5		√ [1]	
5.1.8	√	√	
5.1.10	√	√	√
5.3.1	√ [2]	√ [2]	√ [2]
5.3.2		√ [3]	
5.3.3	√	√	
5.3.4	√	√	

<u>Testing Footnotes:</u>

[1] The Contractor shall handle and record all public complaints. The Contractor shall cease operation of the wireless Ethernet bridge until appropriate action is taken to reduce the interference.

2 The Contractor shall use the same communication frequency channel for testing as it is to be configured in the field. The units shall be capable of transmitting 50% of its specified network load.

3 The Contractor shall verify that the wireless Ethernet bridge operates over the distance as installed.

9. MEASUREMENT FOR PAYMENT

Measurement of the number of wireless Ethernet bridges by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measure is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of documentation and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

DIGITAL VIDEO ENCODERS AND DECODERS – Item No.

Special Provision No. 683S23 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of digital video encoders and digital video decoders. These items allow baseband NTSC analog video signal communication from field CCTV cameras to a head-end equipment location and low speed asynchronous serial camera control signal from the head-end to the camera site over an Ethernet network.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange
TIA/ EIA-422-B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA-485	Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005	IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

International Organization for Standardization:

ISO/IEC 13818	Generic coding of moving pictures and associated audio information (MPEG-2)

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Latency: means the delay between the initiation of a network transmission by a sender and the initial receipt of that transmission by a receiver. It is typically commensurate with the distance the signal must travel, but is also affected by delays introduced in network routing, including queues, multiple routes, packet loss, etc.

MPEG: means the **M**oving **P**icture **E**xperts **G**roup (MPEG), a working group of ISO/IEC charged with the development of video and audio encoding standards.

Multicast: means delivery of information to a group of destinations simultaneously.

Unicast: means sending of information packets to a single destination.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the digital video encoder/decoder to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Digital Communications

5.1.1 The digital video encoder and digital video decoder shall interface to an Ethernet network through a 100BaseTX RJ-45 connection.

5.1.2 The devices shall be compliant with IEEE 802.3 specifications for hardware features implemented.

5.1.3 The devices shall support static or dynamic routing for data flow addressing, and shall support unicast and multicast transmission of digital video.

5.1.4 The devices shall support communication protocols TCP, UDP, IP, DHCP, IGMP, ICMP, ARP, and RTP as a minimum.

5.2 Video Encoder/Decoder Operations

5.2.1 The digital video encoder/decoder shall accept/generate a 1V peak-to-peak ± 0.2, 30 fps, baseband NTSC video signal.

5.2.2 The digital video encoder and decoder shall have an end-to-end latency of no more than 150 milliseconds.

5.2.3 The transmitted digital video encoder/decoder horizontal image resolution, at a minimum, shall have a configuration range of 176 to 720 pixels.

5.2.4 The transmitted digital video encoder/decoder vertical image resolution, at a minimum, shall have a configuration range of 128 to 480 pixels.

5.2.5 The digital video encoder/decoder shall have a minimum of 4 configurable image resolution settings.

5.2.6 The digital video encoder/decoder shall have a configurable frame rate between 1 and 30 fps.

5.2.7 The digital video encoder/decoder shall accept an NTSC composite video cable via a 75-Ohm unbalanced BNC coaxial connector.

5.2.8 Video encoding and decoding shall be based on MPEG-2 protocols (ISO/IEC 13818 standard).

5.3 Serial Communications

5.3.1 The devices shall support bi-directional RS-232, RS-422, and RS-485 serial communications for camera control pan/tilt/zoom functions (PTZ).

5.3.2 The digital video encoder and digital video decoder shall buffer and packetize serial data arriving on the serial port of the device, and transmit it to the destination address that the video is being interchanged with. The packets may contain video, control, and other potential data streams in addition to the serial control data.

5.3.3 The devices shall interface to associated serial devices via a D shell connector, terminal block, or RJ-45 connector. The connections to jointed equipment shall be via cables pinned to present a DTE or DCE device profile compatible with the connected equipment.

5.3.4 The devices shall support “none”, “hardware”, and “software” flow control formats.

5.3.5 The devices shall support serial data rates between 2400 and 19200 bits per second.

5.3.6 The device’s serial data shall be presented in accordance with the data rate, number of data bits, parity, and number of stop bits as the particular device profile has been configured for.

5.4 Configuration

5.4.1 The digital video encoder and digital video decoder shall continually diagnose and provide external visible indication of, but not limited to, power status, video link presence, and link integrity and activity on the Ethernet network.

5.4.2 The devices shall be configurable through an Ethernet connection, and optionally via a serial connection. At a minimum, configuration shall be achieved through a web browser or telnet terminal session.

5.4.3 The devices shall have, at a minimum, the following features configurable:

a) Image resolution;
b) Frame rate;
c) Image quality adjustments (brightness and contrast);
d) Source and destination IP address settings;
e) UDP port number;
f) Bandwidth limits;
g) Unicast and multicast settings; and
h) RS-232/422/485 settings.

5.4.4 All remote commands shall not require the devices to power reset.

5.5 Mechanical

5.5.1 Each device shall be packaged in an electrically shielded enclosure.

5.5.2 Permanent markings shall be provided on the exterior surface to indicate the meaning of diagnostic indicators and any power connector, video connector, serial connector, or configuration setting switches.

5.5.3 The serial number of the device shall be visible from the front or rear of the device.

5.5.4 Any pre-configured IP address shall be noted on a temporary re-writable or replaceable label, visible from the front or rear of the switch.

5.5.5 The device shall be suited for direct rack mounting, or secured to a shelf to facilitate rack mounting. Where the encoder or decoder is a card rack or module based unit, it shall be furnished with a chassis housing suited to mounting one or two modules in a single stand alone case.

5.6 Environmental

5.6.1 The digital video encoder and decoder shall operate in temperatures ranging from - 10^{o} C to + 50^{o} C, with a relative humidity of 10 to 95%, non-condensing.

5.6.2 Devices shall be effectively sealed, or have sensitive components coated in a conformal layer to resist the corrosive effects of a roadside environment.

5.6.3 If forced air-cooling is required, management monitoring of the side effects of fan failure shall be included in the product offering.

5.7 Electrical

5.7.1 The digital video encoder and decoder shall be externally powered using input voltage of 115 VAC ±15%, 60 Hz ±5%.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation and Configuration

7.1.1 The Contractor shall install the digital video encoder and digital video decoder items at locations shown in the Contract Drawings.

7.1.2 If an external power supply component is required for the operation of the switch, means shall be provided to securely fasten the connector to prevent it from becoming accidentally dislodged.

7.1.3 The Contractor shall connect the digital video encoder and decoder power supply cord to the power distribution assembly receptacles reserved for communication equipment, or preferably to the output receptacles where UPS units are present in the cabinet.

7.1.4 The Contractor shall configure an IP address for each device, based on the information provided by the Contract Administrator, in addition to any other required set up configuration settings.

7.1.5 The Contractor shall neatly train and organize all cables.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1	√		
5.1.2	√		
5.1.3	√	√	√
5.2.1	√	√	
5.2.2	√	√	√
5.2.3	√		
5.2.4	√		
5.2.5	√		
5.2.6	√		
5.3.1	√	√	√
5.3.2	√	√	
5.3.6	√		
5.4.1	√		
5.4.2	√	√	
5.4.3	√	√	
5.6.1	√ [1]		

Testing Footnotes:

[1] Environmental testing certificate verifying the stated environmental requirements shall be provided as a condition of equipment acceptance.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of digital video encoders and decoders is by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of payment is each pair.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work including delivery, installation, testing and the production of documentation and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>PORT SERVERS</u> – Item No.

Special Provision No. 683S24 September 2007

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1. SCOPE

This Special Provision covers the requirements for the installation and testing of port servers.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange
TIA/ EIA 422-B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
EIA 485	Standard for Electrical Characteristics of Generators and Receivers for Use in Balanced Digital Multipoint Systems

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005	IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

Port Server: means a device which enables communications to legacy asynchronous serial communication devices over an Ethernet network.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the port servers to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Functional Requirements

5.1.1 The port server shall interface to the Ethernet network through a 10BaseT or 100BaseTX RJ-45 Ethernet connection. The port server shall support auto negotiation on 10/100BaseTX ports.

5.1.2 The port server's Ethernet features implemented shall support relevant IEEE 802.3 protocols.

5.1.3 The port server shall support RS-232, RS-422, and RS-485 serial communication protocols.

5.1.4 The port server shall have a packet error rate (Ethernet interface) and bit error rate (serial interface) of at least 10^{-6} when transmitting serial data at 9600 baud.

5.1.5 The port server shall distribute data out of the serial port from the Ethernet port for IP flows addressed to the device, and as received and distilled from a TCP/IP or UDP/IP Ethernet packet. The serial data shall be presented in accordance with the data rate, number of data bits, parity, and number of stop bits as the device profile has been previously configured for.

5.1.6 The port server shall buffer and packetize serial data arriving on the serial port of the device, and transmit it to the TCP/IP or UDP/IP Ethernet packet destination that the device has been configured to reply to, via the Ethernet port.

5.1.7 The port server shall be configurable through an Ethernet connection, and optionally via a serial connection. At a minimum, configuration shall be achieved through a web browser or telnet terminal session.

5.1.8 The port server shall be capable of operating in a point-to-point manner with another port server connected on the same Ethernet network.

5.1.9 The port server shall be capable of operating in a point-to-multipoint manner with multiple port servers connected on the same Ethernet network. The device shall be capable of processing incoming data from the same remote port servers. As a minimum, the point-to-multipoint mode shall support 2 to 16 port server IP addresses.

5.1.10 The port server shall continually diagnose and provide external visible indication of, but not limited to, power status and link integrity and activity on the Ethernet network.

5.1.11 The port server shall interface to a serial communication device via an appropriately pinned common D-shell connector.

5.1.12 The port server shall utilize socket services to distribute the data without the need to load any software in any communicating device. Software may be loaded on a field maintenance computer to allow initial configuration of the devices. This software and applicable license shall be included in the tender price for the item.

5.1.13 The port server shall support "none", "hardware", and "software" flow control formats.

5.1.14 The port server shall support, at a minimum, data rates between 2400 and 19200 bits per second.

5.2 Environmental

The port server shall be fully operational in external ambient temperatures ranging from – 10^{o} C to + 50^{o} C and relative humidity 10-95% non-condensing.

5.3 Electrical

The port server shall be externally powered using input voltage of 115 VAC ±15%, 60 Hz ±5%.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation and Configuration

7.1.1 The Contractor shall install all port servers as per the manufacturer recommended installation procedure.

7.1.2 The port server shall be installed in locations and/or cabinets identified in the Contract package.

7.1.3 The Contractor shall configure an IP address for each device, based on the information provided by the Contract Administrator.

7.1.4 The Contractor shall set-up and configure the device based on its point-to-point or point-to-multipoint arrangement.

7.1.5 If an external power supply component is required for the operation of the switch, means shall be provided to securely fasten the connector to prevent it from becoming accidentally dislodged.

7.1.6 The Contractor shall connect the port server's power supply cord to the output receptacles on the uninterruptible power supplies (UPS) in the controller cabinets.

7.1.7 The Contractor shall supply and connect all interconnecting electrical cables to the port server as indicated on the drawings.

7.1.8 The Contractor shall neatly train and organize all cables.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1	√	√	√
5.1.3	√	√	
5.1.4	√		
5.1.5	√	√	
5.1. 6	√	√	√
5.1.7	√	√	

CLAUSE	PIT	POP	SIT
5.1.8			√
5.1.9			√
5.1.10	√	√	
5.1.14	√		
5.2	√ [1]		

Testing Footnotes:

[1] Environmental testing certificate verifying the stated environmental requirements shall be provided as a condition of equipment acceptance.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of port servers is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including the production of all drawings, text and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>ETHERNET SWITCHES</u> – Item No.

Special Provision No. 683S25 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation, and testing of Ethernet Switches. The Ethernet switches shall be interconnected to form an Ethernet network enabling communications to ATMS field equipment.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005 IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Electronic Industries Alliance / Telecommunications Industry Association:

TIA/EIA-568-B Commercial Building Wiring Standard

EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Cat 5e cable: means a twisted pair cable type designed for high signal integrity. Currently defined in **TIA/EIA-568-B.** Provides performance of up to 100 MHz, and is frequently used for both 100 Mbit/s and gigabit Ethernet networks.

Latency: means the delay between the initiation of a network transmission by a sender and the initial receipt of that transmission by a receiver. It is typically commensurate with the distance the signal must travel, but is also affected by delays introduced in network routing, including queues, multiple routes, packet loss, etc.

MAC Address: in computer networking means a Media Access Control address (MAC address) is a unique identifier attached to most network adapters.

Rapid Spanning Tree: is an evolution of the Spanning Tree Protocol; it was introduced in the extension IEEE 802.1w, and provides for faster spanning tree convergence after a topology change. Standard IEEE 802.1D-2004 now incorporates RSTP and obsoletes STP.

SNMP: means **simple network management protocol** (**SNMP**) which forms part of the internet protocol suite as defined by the Internet Engineering Task Force (IETF). SNMP is used by network management systems to monitor network-attached devices for conditions that warrant administrative attention.

Spanning Tree: means network protocol as defined by standard IEEE Standard 802.1D.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the Ethernet switches to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 General

5.1.1 The Ethernet switches shall be capable of transmitting Ethernet packets at a rate of a gigabit per second, as defined by the IEEE 802.3-2005 in a full duplex communications mode.

5.1.2 The device shall continually diagnose and provide external visible indication of, but not limited to, power status, link integrity on each electrical/optical port, and data activity on each electrical/optical port.

5.1.3 The device shall be capable of interconnecting a minimum of 30 switches together in a ring topology with a minimum 30% load on the network.

5.1.4 Each device shall support spanning tree protocol and rapid spanning tree protocol as defined in IEEE 802.1d and 802.1w.

5.1.5 The Ethernet switches shall provide support remote network management intelligence and configuration capabilities. At a minimum, the system network management/configuration shall be achieved through a web browser or telnet terminal session. The device shall include all software and licenses required.

5.1.6 Switching latency of the Ethernet switches shall not exceed 10 μs.

5.1.7 The device shall have a minimum mean time between failure (MTBF) of 70,000 hours.

5.1.8 The Ethernet switches shall be suited to EIA 480 mm rack mounting, or secured to a shelf to facilitate EIA 480 mm rack mounting. Any required shelf shall be provided with this item.

5.1.9 The manufacturer, model number, serial number, and firmware version of the device shall be visible on the outside casing of the device.

5.1.10 The devices shall be capable of supporting not less than 1024 MAC Ethernet addresses. The data held in the MAC table shall be automatically aged and managed by the switches to maintain the most current data in the limited MAC addressing table space.

5.1.11 The Ethernet switches shall be compliant with the IEEE 802 specification family for hardware features implemented. At a minimum, this shall include 802.3u (Fast Ethernet 100Mbps), 802.3z (Gigabit Ethernet 1000Mbps fibre), 802.3x (Full Duplex with flow control), 802.1p (QOS Priority Queuing), 802.3q (VLAN), 802.3w (Rapid Spanning Tree), and 802.3ad (Port Trunking).

5.1.12 The devices shall be interoperable with other manufactured Ethernet switches while still achieving all common Ethernet standards.

5.1.13 The device’s management functionality shall be via SNMP V2 or higher.

5.1.14 The Ethernet switches shall be able to restore Ethernet services if any optical path on a redundant ring is broken.

5.2 Environmental

5.2.1 The Ethernet switches shall be fully operational in external ambient temperatures ranging from – 10^{o} C to + 50^{o} C and relative humidity 10-95% non-condensing.

5.2.2 The switches shall withstand a storage temperature range from – 40^{o} C to + 74^{o} C without incurring damage.

5.3 Electrical

5.3.1 The Ethernet switches shall be externally powered using input voltage of 115 VAC ±15%, 60 Hz ±5%.

5.3.2 The Ethernet switches power supply shall have no exposed power connectors.

5.3.3 All power supplies and electrical modules shall suppress unintended radio frequency emissions to CRTC criteria.

5.4 Communications

5.4.1 General

5.4.1.1 The Ethernet switches shall interface to the fibre optic network through 2 pairs (Rx, Tx) of 1000LX singlemode optical fibre ports.

5.4.1.2 Optical ports shall have connectors fitted with LC or SC female optical connectors suited to 9/125μm singlemode cores.

5.4.1.3 The Ethernet switches shall interface to other Ethernet terminal and communication equipment via 10/100BaseTX electrical ports on the switches.

5.4.1.4 The devices shall support auto negotiation on all 10/100BaseTX electrical ports. All electrical ports shall be compliant with the EIA/TIA-568-A standard pinout.

5.4.1.5 The devices shall have an optical link budget to facilitate communications of at least 20 km distances.

5.4.1.6 The Ethernet switches optical receivers shall avoid optical saturation when two of the same devices are connected 100 m apart or greater. If optical saturation occurs on links less than 100 m apart, the Contractor shall supply optical attenuators to prevent saturation.

5.4.2 Field Switches

The field Ethernet switches, intended for placement at remote field cabinets, shall have a minimum of 6 - 10/100BaseTX electrical ports.

5.4.3 Head-end Switches

The head-end Ethernet switches, intended for placement at remote communications hubs, shall have a minimum of 12 - 10/100BaseTX electrical ports.

5.4.4 Central Switches

The central Ethernet switches, intended for placement at the TOCs communications rooms, shall have a minimum of 24 - 10/100BaseTX electrical ports.

5.5 Network Cabling

5.5.1 The Contractor shall supply interface cables and connectors required to connect the switch to the associated equipment and/or patch panels detailed in the Contract Drawings.

5.5.2 The cables shall be CAT 5e or better.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation and Configuration

7.1.1 Prior to installation of Ethernet switches the Contractor shall perform PIT bench testing of the devices in the network configuration detailed in the Contract Drawings.

7.1.2 The Ethernet switches shall be installed in locations and/or cabinets identified in the Contract Drawings.

7.1.3 The Contractor shall install the Ethernet switches as per the manufacturer recommended installation procedure.

7.1.4 The Contractor shall connect the Ethernet switches power supply cord to the output receptacles on the uninterruptible power supplies (UPS) in the controller cabinets.

7.1.5 If an external power supply component is required for the operation of the switches, means shall be provided to securely fasten the connector to prevent it from becoming accidentally dislodged.

7.1.6 The Contractor shall configure an IP address for the Ethernet switches based on the information provided by the Contract Administrator.

7.1.7 The Contractor shall configure all user names and passwords for the Ethernet switches based on the information provided by the Contract Administrator.

7.1.8 The Contractor shall install all interface cable connections between the Ethernet switches and associated equipment. All cables shall be labelled identifying the associated equipment connection.

7.1.9 The Contractor shall neatly train and organize all cables. No cables shall be installed with a radius less than the manufacturer's minimum recommended bending radius.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1	√	√	
5.1.2	√	√	
5.1.3	√	√	√
5.1.4	√	√	√
5.1.5	√	√	√
5.1.6	√	√	√
5.1.14	√	√	√
5.2.1	√ [1]		
5.4.1.5	√	√	
5.4.1.6	√		
7.1.1	√		

Testing Footnotes:

[1] Environmental testing certificate verifying the stated environmental requirements shall be provided as a condition of equipment acceptance.

8. QUALITY ASSURANCE

The Owner may conduct independent testing of the Ethernet Switches supplied to verify their interoperability with other Ethernet switches already owned.

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of Ethernet switches is by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of payment is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work and the production of all drawings, text and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>FIBRE OPTIC ETHERNET MODEMS</u> - Item No.

Special Provision 683S26 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of Fibre Optic Ethernet Modems.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Institute of Electrical and Electronics Engineers:

IEEE 802.3-2005 IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

Electronic Industries Alliance / Telecommunications Industry Association:

TIA/EIA-568-B Commercial Building Wiring Standard
EIA-RS-310-D Cabinets, Racks, Panels and Associated Equipment

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Cat 5e cable: means a twisted pair cable type designed for high signal integrity as currently defined in TIA/EIA-568-B. Provides performance of up to 100 MHz, and is frequently used for both 100 Mbit/s and gigabit Ethernet networks.

FOEM: means Fibre Optic Ethernet Modem

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the Ethernet modems to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 General

5.1.1 The FOEM shall be compliant with IEEE 802 specification family for hardware features implemented.

5.1.2 The FOEM shall continuously diagnose and provide an external visible indication of the following:

Availability of power

Link integrity on the 10/100BASE-TX interface. Link integrity is considered failed when the FOEM is unable to reliably transmit or receive data through the 10/100BASE-TX interface.

Link integrity on the 100BASE-FX interface. Link integrity is considered failed when the FOEM is unable to reliably transmit or receive data through the 100BASE-FX interface.

Data reception on the 10BASE-T and 100BASE-FX interfaces.

5.1.3 A FOEM interconnected by an optical fibre ranging in length from 1 metre to 2000 metres to a second FOEM shall provide half duplex and full duplex end-to-end communications between the two 10/100BASE-TX data ports.

5.1.4 The Fibre Optic Ethernet Modem (FOEM) shall provide full operation over a temperature range from -10° C to +50 C and relative humidity 10-95% non-condensing. While in non-operating mode, shall withstand a temperature range from -20° C to +70° C without incurring damage.

5.1.5 The FOEM shall be EIA 480mm rack mountable or be supplied with a cabinet shelf.

5.1.6 The FOEM shall provide a switch or a user configurable jumper to select operation in half-duplex or full-duplex mode.

5.1.7 The FOEM shall not incur delays greater than 26 bit units or the maximum delay assigned for a typical repeater set as specified by the IEEE 802.3 specification, which ever is less.

5.1.8 The FOEM shall be independently packaged in an electrically shielded enclosure. Permanent markings shall be provided on the exterior surface of the enclosure to indicated each of the optical and electrical interfaces, each of the diagnostics indicators and any configuration switches.

5.2 10BASE-T Interface

5.2.1 The FOEM shall have an 8-position shielded RJ-45 female connector providing a 10/100BASE-TX auto negotiable compatible interface.

5.2.2 The FOEM RJ-45 interface shall support two wiring schemes: a straight through wiring scheme and a crossover wiring scheme. The selection of a particular wiring scheme shall be automated.

5.2.3 The FOEM shall be configured using the appropriate wiring scheme to ensure proper operation of the system using only straight through (non-crossover) 10/100BASE-TX interface cables.

5.2.4 The straight through wiring scheme is defined such that the FOEM shall accept data from any DTE equipment such as a network interface card of an ATC on pin 1 and pin 2 and shall transmit data on pin 3 and pin 6 of the FOEM RJ-45 interface port.

5.2.5 The crossover wiring scheme is defined such that the FOEM shall accept data from any non-DTE equipment such as FOEM RJ-45 interface port.

5.3 100BASE-FX Interface

5.3.1 The FOEM shall provide a 100BASE-FX interface through ST style compatible fibre optic connectors.

5.3.2 The FOEM receiver sensitivity shall be defined as the minimum optical power required to be received by the receiver to operate with a bit error rate of 10^{-9}.

5.3.3 The LED launch power for an FOEM shall be at least 14 dB greater than the receiver sensitivity over the full operating temperature range.

5.3.4 Two FOEMs interconnected by optical fibre with a total optical attenuation between 0 dB and 14 dB shall be capable of providing data communications between two 10/100BASE-TX ports at speeds of at least 10Mb/s.

5.3.5 The FOEM shall transmit information through multimode optical fibre by means of an LED with a nominal centre wavelength of 850 nm at 25° C.

5.3.6 LEDs shall be coupled to optical fibre through an ST style compatible coupling connector receptacle mounted on the FOEM.

5.3.7 The LED launch power shall be defined as the power launched by the LED into one metre of graded index optical fibre with a nominal core dimension of 62.5 µm, a nominal cladding dimension of 125 µm and a numerical aperture of 0.29.

5.3.8 The FOEM receiver shall be coupled to the optical fibre through an ST style compatible coupling receptacle mounted on the Device.

5.3.9 The Contractor shall supply and install optical attenuators, as required, in the event that they are necessary for the proper operation of the system. Attenuators and their method of installation shall be approved by the Contract Administrator.

5.4 Power Supply

5.4.1 The power supply shall operate from an input voltage of 115V ±10%, 60 Hz nominal.

5.4.2 The power supply shall have DC outputs rated to meet the voltage and current requirements of the FOEM.

5.4.3 If the power supply is external to the FOEM, the power supply connection shall be securely fastened to the FOEM.

5.5 Network Cabling

5.5.1 The Contractor shall supply interface cables and connectors required to connect the FOEM to the associated equipment and/or patch panels detailed in the Contract Drawings.

5.5.2 The cables shall be CAT 5e or better.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Installation

7.1.1 The FOEM shall be installed in the cabinets identified in the drawings and shall share the available equipment space with existing equipment.

7.1.2 The Contractor shall install the interface cables between FOEM and controller units and configure with the appropriate wiring scheme to ensure proper operation of the system using only straight through (non-crossover) 10/100BASE-TX interface cables.

7.1.3 Where existing equipment is present, the Contractor shall coordinate the physical space required by the FOEMs to ensure that they will be accommodated in the allocated space.

7.1.4 The Contractor shall connect the correct fibre optic patch cord cable connectors to each FOEM in accordance with the Contract drawings.

7.1.5 The Contractor shall connect the FOEM to the communications outlet of the Power Distribution Assembly. The Contractor shall supply a suitably rated power bar to provide for the multiple modems to be installed at a data node location.

7.1.6 The Contractor shall label the modems at the data node locations with the cabinet identifier the far end modem is installed in.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.2	√		
5.1.3	√	√	√
5.1.4	√		
5.2.1	√		
5.2.2	√		
5.3.2	√	√	
5.3.3	√		
5.3.4	√	√	√

8. QUALITY ASSURANCE

The Owner may conduct independent testing of the FOEM supplied to verify their interoperability with other Ethernet devices already owned.

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of Fibre Optic Ethernet Modems shall be by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work and the production of all drawings, text and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>OUTDOOR CLOSED CIRCUIT TELEVISION CAMERAS</u> - Item No.

Special Provision No. 684S01 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation and testing of CCTV camera and lens, environmental enclosure, video interface cable and camera and accessory power cable and ground wire.

The camera and lens shall be installed as one unit within the weatherproof outdoor enclosure. The above listed items shall be assembled to form a complete and fully operational camera package to be mounted to the pan/tilt unit.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunication Industry Association:

EIA/TIA (RS) 170 Electrical Performance Standards - Monochrome Television Studio Facilities (NTSC Standard)

National Electrical Manufacturers Association (NEMA):

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) – NEMA 4

Others:

Canadian Electrical Code (CEC)

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definition applies:

NTSC: means the analog television system used in Canada and U.S. named for the **National Television System(s) Committee**.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the CCTV camera, lens, environmental enclosure, cables and connectors to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 CCTV Camera and Lens

The camera and lens shall form an operational unit.

5.1.1 Functional

5.1.1.1 The camera shall be designed for use at low light levels and shall have a wide dynamic range and minimal blooming and transfer smear characteristics.

5.1.1.2 The camera shall provide a minimum of 480 lines horizontal resolution.

5.1.1.3 The camera shall provide backlight compensation for variations in scene brightness.

5.1.1.4 The camera shall provide automatic light balance with range from 2000^{o} K to $10{,}000^{o}$ K.

5.1.1.5 The camera shall incorporate AGC circuitry to provide for compensation at low light levels. The AGC shall be user settable with a minimum of 24 dB of gain.

5.1.1.6 The camera shall operate from a TIA standard RS-170 sync as provided by an internal integrated sync generator and phased locked loop circuit to synchronize camera to power line zero crossing. The camera shall allow vertical phase adjustment.

5.1.1.7 The camera shall have an output impedance of 75 ohms and shall provide a standard colour NTSC composite video signal output.

5.1.1.8 The composite video signal shall be 1 volt peak to peak (140 IRE) from synchronizing tip (-40 IRE) to white luminance level (100 IRE). The reference level shall be blanking level at 0 IRE units. The black (setup) level shall be 7.5 IRE units. The chrominance information may extend as much as 23 IRE below to 30 IRE above the luminance range, allowing a maximum positive video signal excursion of +130 IRE and a minimum video signal excursion of -23 IRE. If the camera output does not comply to this requirement and additional material is required to achieve this, it shall be included in the cost of this item.

5.1.1.9 The weighted signal to noise ratio shall be greater than 50 dB at 1.0 V p-p (AGC off).

5.1.1.10 The camera shall make use of a 8.5 mm (1/3”) colour, inter-line transfer, solid state CCD image sensor with a minimum of 768 (H) x 492 (V) active pixels.

5.1.1.11 The camera shall be capable of providing a high contrast colour picture with a full video output at a minimum illumination of 3 lux @ f 1.4 (100 IRE, AGC on) lux and a useable picture at a minimum of 0.8 lux at F1.4 (50 IRE, AGC on).

5.1.1.12 The camera shall allow vertical phase adjustment.

5.1.1.13 The lens shall provide a minimum focal length range of 6-90 mm and shall be adjusted via control voltages from the camera control receiver.

5.1.1.14 The lens shall include zoom/focus preset position potentiometers.

5.1.1.15 Power interruption protection shall be provided to close the lens iris in case of power loss.

5.1.1.16 The lens shall be held closed by a delay circuit for a minimum of 5 seconds when power start-up occurs.

5.1.1.17 The lens shall be designed to prevent bright light "flare" caused by indirect sunlight outside the angle of view of the lens affecting the viewed scene.

5.1.1.18 The lens shall be a 8.5 mm (1/3") format, "CS/C" mount, zoom lens with automatic iris and spot filter.

5.1.1.19 The automatic iris shall include a neutral density spot filter providing a minimum total aperture adjustment of f/1.2 to f/720.

5.1.2 Physical

5.1.2.1 Camera dimensions shall not exceed 60 mm H x 54 mm W x 120 mm L.

5.1.2.2 Externally accessible controls shall be kept to a minimum in order to prevent incorrect adjustment.

5.1.2.3 The camera shall be suitable for mounting of a standard "CS" mount lens.

5.1.2.4 Standard 6 mm (1/4") - 20 tapped thread mount holes shall be provided at the base of the camera/lens assembly for balanced mounting.

5.1.2.5 Interconnect harness type wiring between and compatible with the lens, camera and camera control receiver for ZOOM, FOCUS and AUTO IRIS functions shall be provided.

5.1.2.6 A quick disconnect BNC connector shall be provided for video output on the rear panel of the camera.

5.1.2.7 Lens dimensions shall not exceed 88.5 mm H x 78 mm W x 119 mm L.

5.1.2.8 The camera assembly (camera and lens) shall have a maximum weight of 1.5 kg.

5.1.3 Electrical

5.1.3.1 The camera shall include any required power supply/adaptor equipment to enable its operation from an input voltage of 120 VAC ±10%, 60 Hz ±5%. Any external power supply supplied shall be included in the tender price for this item.

5.1.3.2 The maximum power consumption of the camera and lens shall not exceed 10 W.

5.1.4 Environmental

As a minimum, the operating temperature range of the camera and lens shall be – 10^{o} C to + 50^{o} C.

5.2 Environmental Enclosure

5.2.1 Functional

5.2.1.1 The enclosure shall be of a size suitable for housing the CCTV camera, lens, ventilation fan and heater.

5.2.1.2 Access to the environmental enclosures shall be provided by a hinged top cover, secured by a minimum of two (2) quick release latches.

5.2.1.3 A finished sunshield shall be mounted to the environmental enclosure to protect from heat due to direct solar radiation, while permitting air flow over the housing exterior without interfering with cover operation.

5.2.1.4 Provision shall be made to securely mount the CCTV camera and lens to the base of the environmental enclosure.

5.2.1.5 Provision shall be made to securely mount the environmental enclosure to the pan/tilt drive.

5.2.1.5 The ventilation fan shall provide an internal positive pressure.

5.2.1.6 The enclosures shall allow for waterproof entry and easy removal of all external cable.

5.2.2 Physical

5.2.2.1 The environmental enclosure should have minimum useable internal dimensions of 90 mm H x 80 mm W x 460 mm L.

5.2.2.2 The weight of the environmental enclosure including sunshield, ventilation fan and heater accessories shall not exceed 4.5 kg.

5.2.3 Electrical

5.2.3.1 The ventilation fan shall require a maximum power consumption of 20 W at 115 VAC ± 15%, 60 Hz ± 5%.

5.2.3.2 The thermostat equipped heaters should operate on an input voltage of 115 VAC ± 15%, 60 Hz ± 5% to generate a total of 150 watts (2 x 75) of heat energy.

5.2.3.3 An additional two 75 watt heaters shall be provided as spares and turned over to the Contract Administrator.

5.2.3.4 The environmental enclosure shall have a grounded duplex receptacle providing 115 VAC ± 15%.

5.2.4 Environmental

5.2.4.1 The heater shall be provided complete with thermostat control to maintain internal enclosure temperatures above + 4^{o} C with an external temperature of – 40^{o} C.

5.2.4.2 Heaters with thermostat control shall activate at temperatures less than or equal to + 4^{o} C and shall turn off when temperatures are above + 10^{o} C.

5.2.4.3 The thermostat control shall activate a ventilation fan at temperatures above + 33^{o} C and automatically turn off when temperatures fall below + 26^{o} C.

5.3 Video Interface Cable

5.3.1 Wiring

The video interface cable between the pole mounted camera and the Video Transmitter or Video Modulator shall meet the following requirements:

5.3.1.1 The cable shall have a black PVC jacket and its outer diameter shall be 6.15 mm.

5.3.1.2 The outer conductor shall be bare copper mesh of no less than 95 % shield coverage.

5.3.1.3 The centre conductor shall be 22 AWG consisting of 7 - # 30 AWG bare copper strands.

5.3.1.4 The dielectric shall be cellular polyethylene.

5.3.1.5 The nominal impedance shall be 75 ohms and the d.c. loop resistance shall be 49.2 ohms/km.

5.3.2 Connectors

Connectors shall be BNC Amphenol RG-59, crimp-crimp termination or match manufacturer specifications.

5.4 Video Tap

The video tap shall be a standard coaxial 2-way base band splitter and standard 75 ohm terminators.

5.5 Lens Control Cable - 12 Conductor, #20 AWG, Shielded

5.5.1 The 12 conductor, #20 AWG, shielded control cable shall consist of six (6) individually shielded cable pairs with tinned copper strand conductors.

5.5.2 Each conductor shall be insulated with polypropylene jacket. Each conductor pair shall be shielded with an aluminium-polyester tape wrap with a copper drain wire.

5.5.3 The 12 conductor, # 20 AWG, shielded control cable shall have an overall PCV jacket.

5.5.4 Each conductor shall be colour coded for positive identification.

5.5.5 The resistance of each conductor shall not exceed 3.38 ohms per 100 m at 20^{o}C.

5.5.6 Each conductor shall have a current handling capacity of 5 amperes minimum.

5.6 Power Cables And Ground Wire

Camera and accessory power cable shall be a 3-conductors #18 AWG type SOW and shall be terminated with a 5-15P plug at the cabinet end.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 CCTV Camera Lens

The camera and lens shall be firmly attached at the 'C'-mount to form one operational unit and shall meet the following requirements:

7.1.1 The CCTV camera and lens shall be securely mounted to the base of the environmental enclosure;

7.1.2 The camera shall be set to operate in AC line lock mode;

7.1.3 The Contractor shall field adjust the vertical phase control of each camera, using the following method, such that the video signals arriving at the control centre are synchronized:

a) select a camera video signal at the output of the video switch, this will be the reference signal;
b) input the reference signal into Channel A of an oscilloscope. Select the camera to be adjusted on another output of the video switch and input this video signal into Channel B of the oscilloscope;
c) adjust the vertical phase control of the camera in the field on Channel B until the vertical sync pulses are in phase;
d) repeat at each camera location; with the video signal on Channel A maintained as the reference.

It should be noted that the above procedure requires two people, one at the video switch and one at the camera location. The two people must be able to communicate to one another.

7.1.4 The camera shall be mounted within the enclosure such that lens and window separation is kept to a minimum when the lens is fully extended;

7.1.5 Any external power supplies shall be securely mounted within the enclosure;

7.1.6 The camera shall be supported within the enclosure in a manner that ensures that the weight of the camera does not rest on the lens mount. The Contractor is responsible for supplying and installing required hardware including mounting spacers between the enclosure and camera to ensure that balanced mounting is achieved.

7.2 Environmental Enclosure

7.2.1 The environmental enclosure including camera, lens, heaters and ventilation equipment shall be mounted securely to the top of the pan/tilt unit.

7.2.2 The Contractor shall ensure that the entire pole top assembly is grounded via a ground wire to the controller cabinet.

7.3 Wiring

7.3.1 General

7.3.1.1 Interface cable and connectors shall be installed to make the video subsystem completely operational.

7.3.1.2 Wiring shall run continuous from source to destination. No splices shall be accepted.

7.3.1.3 Wiring shall be neatly tagged at both terminations to indicate source and destination and function.

7.3.1.4 Sufficient slack shall be provided for equipment movement.

7.3.1.5 All electrical cable shall meet the requirements of the Ontario Electrical Safety Code.

7.3.2 Installation Requirements

7.3.2.1 Video and data interconnect cables required to connect the camera and lens and communications interface unit shall be routed from the camera to the cabinet in which the communications unit is housed through the conduit system. Video interconnect cable shall be installed in continuous neoprene tubing between the top of the pole and the camera housing and between the pole handhole and the controller cabinet.

7.3.2.2 The video tap shall be installed at the point of connection of the video interconnect cable and the communications interface.

7.4. Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.1	√		√
5.1.1.2	√		√
5.1.1.3	√		
5.1.1.4	√		
5.1.1.5	√		
5.1.1.6	√		
5.1.1.7	√	√	
5.1.1.8	√	√	
5.1.1.9	√	√	
5.1.1.10	√		√
5.1.1.11	√		
5.1.1.12	√		√
5.1.1.13	√		

CLAUSE	PIT	POP	SIT
5.1.1.14	√		
5.1.1.17	√		√
5.1.1.19			√
5.2.1.1	√		
5.2.4.3	√		

8. QUALITY ASSURANCE

Following the integration of CCTV cameras, the Owner will make a qualitative assessment of camera operation from the Traffic Operations Centre (TOC) including:

a) Image blooming during night-time operation;
b) Colour quality;
c) Low light image quality;
d) Daytime image quality under bright sun light.

9. MEASUREMENT FOR PAYMENT

Measurement of the number of outdoor closed circuit TV cameras is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including delivery, installation, testing and the production of all drawings, documentation and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>OUTDOOR PAN / TILT UNITS</u> - Item No.

Special Provision No. 684S03 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation of an outdoor pan/tilt drive unit, cableguard, and pole cap bracket.

2. REFERENCES – Not Used

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMSSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the outdoor pan/tilt units, wiring and connectors to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Outdoor Pan / Tilt Drive Unit

5.1.1 General

5.1.1.1 The travel angle of the pan/tilt drive unit shall be from 0^o to 350^o in the horizontal (pan) mode, and $\pm 90^o$ in the vertical (tilt) mode.

5.1.1.2 The pan/tilt drive unit shall have instantaneously reverse motor action and dynamic braking shall be incorporated to prevent drift.

5.1.1.3 The pan/tilt drive unit shall pan at a minimum speed of 7^o per second, and tilt at a minimum of 4^o per second.

5.1.1.4 The pan/tilt drive unit shall be fully load rated to accept the camera lens and lens controller and weatherproof outdoor enclosure under wind load conditions of 140 km/hr with 13 mm ice coating. It shall also be load rated to at least 36 kg.

5.1.1.5 The pan/tilt unit shall be capable of setting pan/tilt stops to limit the camera’s viewing coverage.

5.1.2 Physical

5.1.2.1 The pan/tilt drive unit housing shall be constructed of cast aluminium with a baked enamel texture. Heavy duty roller bearings shall be used on all rotating surfaces. All rotor gears shall be made from hardened steel and low temperature lubricant shall be used. Gasket seals shall be incorporated to ensure all-weather protection.

5.1.2.2 Mounting holes shall be located to provide for securely mounting the pan/tilt drive unit to the pole, using the pole cap bracket as shown in the drawings. Provision shall be made for mounting the weatherproof outdoor enclosure with camera assembly securely and at the correct pivot point.

5.1.2.3 The dimensions of the pan and tilt drive unit shall be capable of securing it to the pole cap bracket and be suitable for the camera housing.

5.1.2.4 The weight of the pan and tilt drive unit shall not exceed 16.5 kg.

5.1.3 Electrical

5.1.3.1 Input voltage shall be 120 VAC ±15%, 60 Hz ±5%.

5.1.3.2 Pan and tilt drive motors shall have a total power consumption of 75 watts maximum and shall have internal overload protection. It shall not exceed a current of 5 amps.

5.2 Interconnect Wiring

5.2.1 16 Conductor, #18 AWG Shielded Pan/Tilt Control Cable

5.2.1.1 The 16 conductor, #18 AWG, shielded control cable shall consist of eight (8) individually shielded cable pairs with tinned copper strand conductors.

5.2.1.2 Each conductor shall be insulated with a PVC jacket. Each conductor pair shall be shielded with an aluminium-polyester tape wrap with a copper drain wire.

5.2.1.3 The cable shall have an overall aluminium-polyester shield.

5.2.1.4 The 16 conductor, #18 AWG, shield control cable shall have an overall FRPVC jacket of no less than 1.14 mm thickness.

5.2.1.5 Each conductor pair shall be coded for positive identification.

5.2.1.6 The resistance of each conductor shall not exceed 2.34 ohms per 100 m at 20^{o}C.

5.2.1.7 Each conductor shall have a current handling capacity of 5 amperes minimum.

5.2.1.8 Each conductor shall be supplied with a male 14 pin AMP connector model AMP206044-1 for connection to controller.

5.2.1.9 All cable connectors shall be fully weather protected.

5.2.2 Cableguard

The cableguard shall consist of an aluminium rod and shall be complete with attaching hardware.

5.3 Pole Cap Bracket

The pole cap bracket shall be as indicated in the Contract Drawings.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 General

7.1.1 The pan/tilt units, cables, and cableguards shall be installed securely as shown in the drawings.

7.1.2 The pan/tilt range settings shall be individually set by the Contractor as approved by the Contract Administrator at each camera site during installation.

7.1.3 The cable guard shall be installed to protect the cable harness.

7.1.4 Interconnect wiring and connectors shall be supplied and installed to make the camera control subsystem completely operational.

7.1.5 Wiring shall run continuous from source to destination. No splices shall be accepted.

7.1.6 Wiring shall be neatly tagged at both terminations to indicate source and destination and function.

7.1.7 Sufficient slack shall be provided for equipment movement.

7.1.8 All cabling shall be secured and protected as necessary to the satisfaction of the Contract Administrator.

7.1.9 All interconnecting wiring and connectors shall meet all equipment requirements with regards to voltage, current and environmental ratings.

7.1.10 All cables shall be installed in continuous neoprene tubing between the top of the pole and the pan/tilt unit and between the pole handhole and the controller cabinet. The cabling and connector shall be installed to allow future disconnection without the need to remove the pan/tilt housing.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.1	√	√	√
5.1.1.2	√	√	
5.1.1.3	√	√	
5.1.1.5		√	
7.1.2		√	

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement for payment of each outdoor pan / tilt unit is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except SIT which is paid for under a separate item.

WARRANT: Always with this item.

CLOSED CIRCUIT TELEVISION VIDEO MONITORS - Item No.

Special Provision No. 684S07 September 2007

1. SCOPE

This Special Provision covers the requirements for the supply, installation and testing of monitors. These items shall be integrated and compatible with the video switching and control system.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunication Industry Association:

EIA/TIA (RS) 170 Electrical Performance Standards - Monochrome Television Studio Facilities (NTSC Standard)

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Contrast Ratio: means the ratio of the luminosity of the brightest and the darkest color the system or device is capable of producing.

Luminance: means a photometric measure of the density of luminous intensity in a given direction. It describes the amount of light that passes through or is emitted from a particular area, and falls within a given angle. The SI unit for luminance is candela per square metre (cd/m2).

LCD: means liquid crystal display.

NTSC: means the analog television system used in Canada and U.S. named for the **National Television System(s) Committee**.

SXGA: means screen resolution of 1280 x 1024 pixels.

TFT: means thin film transistor.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit all monitor setup parameters to the Contract Administrator after installation and testing.

5. MATERIALS

5.1 CCTV Video Monitors

5.1.1 The monitors shall be color, flat panel active matrix TFT LCD.

5.1.2 The monitors shall have a minimum resolution of 1280 by 1024 pixels (SXGA).

5.1.3 The LCD display shall be capable of more than 16.7 million colours.

5.1.4 Monitor response time shall be less than 12 ms.

5.1.5 All internal circuitry shall incorporate solid state design throughout.

5.1.6 Operating controls for picture set and adjustment and power on/off shall be located in the front of the monitor.

5.1.7 At a minimum, the monitors shall be capable of adjusting luminance, contrast ratio, horizontal and vertical position.

5.1.8 Each video monitor housing shall have a non-reflecting black paint finish.

5.1.9 All monitors shall be CSA approved.

5.1.10 Upon recovery from a power failure, all monitors shall return to pre-power failure ON or OFF state automatically.

5.1.11 Contractor shall install active ground loop current isolator, which utilizes operational amplifier circuits. If external isolator is used, it shall be black in colour and securely fastened in the console.

5.1.12 The units shall have a MTBF of at least 40,000 hours.

5.2 508 mm (20 inch) Monitor Bank Unit

5.2.1 The monitors shall have a minimum luminance output of 500 cd/m^2.

5.2.2 The monitors shall have a minimum contrast ratio of 800:1.

5.2.3 The monitors shall have a minimum field of view of 170^o horizontal and 170^o vertical.

5.3 432 mm (17 inch) Desk Top Unit

5.3.1 The monitors shall have a minimum luminance output of 250 cd/m^2.

5.3.2 The monitors shall have a minimum contrast ratio of 500:1.

5.3.3 The monitors shall have a minimum field of view of 160^o horizontal and 160^o vertical.

5.4 Physical

5.4.1 The outside dimensions of the 508 mm monitors shall not exceed: 410 mm H x 490 mm W x 90 mm D. The maximum height with mounting bracket shall not exceed 460 mm. The weight shall not exceed 9 kg, for the panel only.

5.4.2 The outside dimensions of the 432 mm monitors shall not exceed: 395 mm H x 380 mm W x 70 mm D. The weight shall not exceed 7 kg, for the panel only.

5.4.3 The monitors shall be able to operate over an ambient temperature range of 10^{o} C to 40^{o} C, at 20% to 80% relative humidity.

5.4.4 The Contractor shall be responsible for all mounting hardware.

5.5 Electrical

5.5.1 The composite video (NTSC) input level shall be 1.0 +/- 0.2 Volt peak to peak (V p-p) sync-negative and shall be looped to the video output ports. These ports shall be terminated into 75 ohms, if unused, with BNC type connectors.

5.5.2 The composite video input impedance to the monitor shall be switch selectable for either 75 ohms or high impedance. Two inputs to be supplied for the 508 mm units.

5.5.3 The monitors shall have at least one female S-video input connector.

5.5.4 The monitors shall have at least one female 15 pin RGB input connector.

5.5.5 The monitors shall have at least one female DVI-D input connector.

5.5.6 The monitors shall be powered from a standard electric supply outlet of 115 VAC +/-15%, 60 Hz +/- 5%, using a grounded power cord and shall have an isolation power transformer.

5.5.7 The power consumption shall be no greater than 86 Watts for the 508 mm unit and 45 Watts for the 432 mm unit.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The Contractor shall install the monitors in the existing monitor racks and consoles as detailed in the Contract or as directed by the Contract Administrator.

7.2 The Contractor shall remove the existing monitor units and deliver to a location specified by the Owner.

7.3 The Contractor shall connect the monitors to the existing video switch outputs as detailed in the Contract or as directed by the Contract Administrator.

7.4 The units shall be connected to the existing power supply outlets located in the monitor racks and consoles.

7.5 The Contractor is responsible for the set-up of the monitor parameters to optimize the visual operation as required within a control centre environment including but not limited to brightness, contrast, hue, colour, sharpness and tint.

7.6 All monitors set-up shall have consistent image quality.

7.7 The work shall be coordinated with the COMPASS Operations staff providing a minimum of 24 hours notice prior to commencing the work. The work shall be conducted during off peak traffic periods.

7.8 The Contractor shall inject at least three (3) NTSC standard patterns to confirm operation of all input and output ports.

7.9 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.2	√		
5.2.3		√	
5.3.3		√	
7.6		√	
7.8	√		

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of CCTV video monitors is by Plan Quantity as may be revised by Adjusted Plan Quality.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Material required to do the work, except for SIT which is paid for under a separate item.

WARRANT: Always with these items.

<u>DOME CAMERAS</u> – Item No.

Special Provision No. 684S10 September 2007

1. SCOPE

This Special Provision covers the requirements for installation and testing of dome cameras consisting of an image sensor, zoom lens, pan and tilt functions, weatherproof outdoor dome assembly, mounting hardware, and camera, power, and ground wiring, at the locations shown in the Contract Drawings. The above listed items shall be installed to form a complete and fully operational camera assembly to be pole mounted.

The Contractor shall supply software for local camera control and configuration.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Canadian Standards Association:

CAN/CSA C22.2 NO. 60950-00 Safety of Information Technology Equipment (Bi-national standard, with UL 60950) Canada National Standard/Canadian Standards

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA (RS) 170 Electrical Performance Standards - Monochrome Television Studio Facilities (NTSC Standard)

National Transportation Communications for ITS Protocol (NTCIP):

NTCIP 1205: 2001 NTCIP Objects for CCTV Camera Control

National Electrical Manufacturers Association (NEMA):

NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum) – NEMA 4 Type

Others:

Canadian Electrical Code (CEC)

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

IP: means Internet Protocol.

Management System: means a computer system used to control an NTCIP component. This includes any NTCIP compliant local control software used for field control as well as the central control software.

NTSC: means the analog television system in Canada and U.S., named for the **National Television System(s) Committee.**

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall supply the specification sheets for the dome cameras to the Contract Administrator for review prior to ordering.

The Contractor shall submit voltage drop calculations for dome camera power cables.

5. MATERIALS

5.1 Integrated Dome Camera and Lens

5.1.1 Functional

5.1.1.1 The camera shall be designed for use at low light levels and shall have a wide dynamic range and minimal blooming and transfer smear characteristics.

5.1.1.2 The camera shall be capable of providing a high contrast colour picture with a full video output at a minimum illumination of 1.0 lux.

5.1.1.3 The camera shall provide a minimum of 470 lines horizontal resolution.

5.1.1.4 Automatic light range circuits shall be included to provide compensation for variations in scene brightness. The circuits shall provide pictures over a light range of 1 million to 1.

5.1.1.5 The camera shall incorporate AGC circuitry to provide for compensation at low light levels.

5.1.1.6 The lens shall provide a minimum focal length range of 4-88mm compensated with a minimum 10x digital zoom and shall be remotely controllable from the camera control transmitter at TOC.

5.1.1.7 The lens shall be designed to prevent bright light "flare" caused by indirect sunlight outside the angle of view of the lens affecting the viewed scene.

5.1.1.8 The dome camera shall include an integral receiver/driver. The receiver/driver shall be capable of controlling pan-tilt, zoom and focus and be compatible with American Dynamics MegaPower 1024 video switch matrix.

5.1.1.9 Pan travel shall be 360^{o} continuous.

5.1.1.10 Tilt travel shall be a minimum 100^{o}. The tilt capability shall include both the horizontal (level view) and vertical (downward view) position. If the camera travels beyond straight down, automatic image flip circuitry shall prevent the display of an inverted image.

5.1.1.11 Manual pan and tilt shall be operated at a variable rate based on the current zoom level. The rate shall be 0.25^{o} to 50^{o} per second or better.

5.1.1.12 The camera shall make use of a 6 mm (1/4 inch) colour, inter-line transfer, solid state CCD image sensor with a minimum of 768 (H) x 494 (V) active pixels.

5.1.1.13 The camera shall allow vertical phase adjustment.

5.1.1.14 The lens shall be integrated with the dome camera.

5.1.1.15 The lens shall be a 6 mm (1/4 inch) format zoom lens.

5.1.1.16 The automatic iris shall include a neutral density spot filter providing a minimum aperture of f1.6.

5.1.1.17 Power interruption protection shall be provided to close the lens iris in case of power loss.

5.1.1.18 The lens shall be held closed by a delay circuit for a short period when power start-up occurs.

5.1.1.19 The pan and tilt mechanism shall be an integral part of the dome camera.

5.1.1.20 Automatic pan and tilt presets shall operate at a rate of 100^{o} per second or better.

5.1.1.21 There shall be a minimum of 10 assignable automatic preset positions.

5.1.1.22 There shall be a minimum of 8 definable privacy zones.

5.1.2 Physical

5.1.2.1 A quick disconnect BNC connector shall be provided for video output.

5.1.2.2 A quick disconnect for power shall be provided.

5.1.2.3 The camera assembly (camera, lens, and housing) shall have a maximum weight of 1.6 kg.

5.1.2.4 The lens, wiring, and all other components shall be integrated within the CCTV camera module and shall fit within the specified camera dimensions.

5.1.3 Electrical

5.1.3.1 The weighted signal to noise ratio shall be greater than 50 dB at 1.0 V p-p (AGC off).

5.1.3.2 The composite video signal shall be 1 volt peak to peak (140 IRE) from synchronizing tip (-40 IRE) to white luminance level (100 IRE) when presented with a white scene to image. The reference level shall be blanking level at 0 IRE units. The black (set-up) level shall be 7.5 IRE units. The chrominance information may extend as much as 23 IRE below to 30 IRE above the luminance range, allowing a maximum positive video signal excursion of +130 IRE and a minimum video signal excursion of -23 IRE.

5.1.3.3 The camera control functions shall be controlled by an integrated receiver/driver. The receiver/driver shall operate at an electrical interface level via RS-422 or RS-485 protocols, and shall be appropriately terminated.

5.1.3.4 The camera assemblies shall be CSA approved.

5.1.3.5 The camera module shall include any required power supply/adaptor equipment to allow operation from an input voltage of 24 VAC ±10%, 60 Hz ±5%. If an external power supply is required to accommodate this voltage, it shall be included in the tender price for this item.

5.1.3.6 The maximum power consumption of the camera and lens shall not exceed 16 W.

5.1.3.7 The power, video, and data cable connections to the controller cabinet shall include surge protection.

5.1.3.8 The camera shall operate from a TIA standard RS-170 sync as provided by an internal integrated sync generator and phased locked loop circuit to synchronize camera to power line zero crossing.

5.1.3.9 The camera shall have an output impedance of 75 ohms and shall provide a standard colour NTSC composite video signal output.

5.1.4 Control Protocol

The control protocol shall be American Dynamics Sensormatic protocol (AD) and NTCIP 1205 v1.08 control protocol.

NTCIP protocol:

5.1.4.1 The camera shall support all mandatory conformance groups in NTCIP 1205:2001 v1.08 or greater.

5.1.4.2 The vendor shall disclose if they support the optional conformance group objects related to motion control and on screen menu control proposed by the presently circulating amendment v1.08 of NTCIP 1205.

5.1.4.3 The underlying NTCIP standards related to global objects and serial communications physical channels shall also be supported.

5.1.4.4 The camera vendor shall disclose any proprietary MIB objects in addition to the above listed NTCIP standards to achieve camera control.

Protocol conversion:

5.1.4.5 The two different protocols shall be accessed either by the appropriate dip switch settings, or by the installation of appropriate ‘language’ sub-boards. All materials and documentation required to convert protocols shall be supplied.

5.1.4.6 The camera will be operated using the AD protocol in the system integration tests and until the completion of this Contract. This protocol shall be suited to tightly integrate with the existing AD video switch matrix model Mega Power 1024, without loss of any camera control functionality.

5.1.4.7 These cameras in the future will be converted to operate using NTCIP 1205 protocol.

5.2 Environmental Housing

The environmental housing shall provide a temperature controlled atmosphere for the camera, lens and receiver-driver.

5.2.1 Functional

5.2.1.1 The housing shall be of a size suitable for housing the dome CCTV camera, lens, receiver-driver, and environmental controls.

5.2.1.2 The housing shall be weather and tamper-proof, protecting camera from outdoor temperatures ranging from -40^{o} C to $+50^{o}$ C.

5.2.1.3 The housing shall allow for easy disconnect of all external cables.

5.2.2 Physical

5.2.2.1 The housing shall utilise a clear optical grade thermoformed acrylic or equivalent grade bubble to house the optical components. This bubble shall securely attach to the housing, with sufficient fasteners to ensure that sealing gaskets are well compressed.

5.2.2.2 The housing shall include a safety harness attached to the optical bubble to prevent it from becoming accidentally detached during servicing.

5.2.2.3 The upper portion of the housing shall be formed from shape painted metal.

5.2.2.4 All points for mounting or for cable egress shall be gasket sealed, or other weatherproofing measures provided.

5.2.2.5 The housing design shall incorporate a “drip ring” to keep rainwater from the bubble.

5.2.2.6 The weight of the environmental housing including sunshield, ventilation fan, and shall not exceed 4.50 kg.

5.2.2.7 Provision shall be made to securely mount and align the dome CCTV camera inside the environmental housing.

5.2.3 Electrical

5.2.3.1 The camera assembly shall be CSA approved.

5.2.3.2 The camera assemblies shall include any required power supply/adaptor equipment to enable its operation from an input voltage of 120 VAC ±10%, 60 Hz ±5%. Any external power supply supplied shall be included in the tender price for this item.

5.2.3.3 The power consumption of the camera assembly shall not exceed 80W.

5.2.4 Environmental

5.2.4.1 The housing with the dome camera installed shall be suited to withstand wind gusts of 160 km/h.

5.2.4.2 The housing shall meet the NEMA 4 standard for particulate and moisture resistance.

5.3 Video Interface Cable

5.3.1 Wiring

The video interface cable between the pole mounted camera and the Video Transmitter shall meet the following requirements:

5.3.1.1 The cable shall be RG-59 and shall have a black PVC jacket and its outer diameter shall not exceed 7 mm.

5.3.1.1 The outer conductor shall be bare copper mesh of no less than 95% shield coverage.

5.3.1.3 The RG-59 centre conductor shall be 22 AWG consisting of 7-30 AWG bare copper strands.

5.3.1.4 The dielectric shall be cellular polyethylene.

5.3.1.5 The nominal impedance shall be 75 ohms and the d.c. loop resistance shall be 49.2 ohms/km.

5.3.2 Connectors

5.3.2.1 Connectors shall be BNC Amphenol RG-59, crimp-crimp termination or match manufacturer specifications.

5.4 Data and Power Cabling

5.4.1 The data interface cable shall be a minimum shielded #18 AWG with tinned copper strand conductors.

5.4.2 The power cable shall be terminated with a 5-15P plug in the controller cabinet. The size of power cable shall be dependent on the distance between camera pole and controller cabinet. The wiring size shall be as follows:

a) #14 AWG for sites where cabinet is located within 20m from camera pole
b) #12 AWG for sites where cabinet is located within 20 to 50m from camera pole
c) #10 AWG for sites where cabinet is located within 50 to 95m from camera pole

These values were assessed based on maximum voltage drop of 3V. The Contractor shall provide calculations to verify that equipment supplied under this Contract item meets the above requirements.

5.4.3 Each conductor shall be insulated with a PVC jacket and suited for wet conditions.

5.4.4 The cables shall have an overall PVC jacket of no less than 0.7 mm thickness.

5.4.5 Each conductor shall have a current handling capacity of 3 amperes minimum.

5.4.6 The Contractor shall supply any junction boxes, fabricated from PVC, cast aluminium, or stainless steel to make any necessary pole top junctions.

5.4.7 The cabling at the pole top shall be pulled in flexible watertight conduit suited for outdoor installation in any locations where the cabling is exposed.

5.4.8 Connectors shall conform to equipment requirements and shall be approved by the Contract Administrator.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 General

7.1.1 The integrated dome CCTV camera and lens module shall be securely mounted in the environmental housing.

7.1.2 The Contractor shall firmly attach the dome camera and environmental housing to the CCTV pole.

7.1.3 The Contractor shall ensure that the entire pole top assembly is grounded via a ground wire to the controller cabinet.

7.1.4 Any required external power supplies shall be securely mounted within the cabinet.

7.1.5 The dome assembly shall be integrated with camera raising and lowering equipment on a concrete pole. The dome assembly shall be firmly attached to the raising and lowering equipment to form one operational unit. The arm alignment for each location shall be verified with the Contract Administrator prior to the installation.

7.1.6 The Contractor shall field adjust the vertical phase control of each camera, using the following method, such that the video signals arriving at the control centre are synchronized:

a) select a camera video signal at the output of the video switch; this will be the reference signal;

b) input the reference signal into Channel A of an oscilloscope. Select the camera to be adjusted on another output of the video switch and input this video signal into Channel B of the oscilloscope;

c) adjust the vertical phase control of the camera in the field on Channel B until the vertical sync pulses are in phase;

d) repeat at each camera location with the video signal on Channel A maintained as the reference.

It should be noted that the above procedure requires two people, one at the video switch and one at the camera location. The two people must be able to communicate to one another.

7.2 Wiring

7.2.1 Interface cables and connectors shall be installed to make the video subsystem completely operational.

7.2.2 Wiring shall run continuous from source to destination. No splices shall be accepted.

7.2.3 Wiring shall be neatly tagged at both terminations to indicate source and destination and function. All cables shall be labelled in accordance with their function.

7.2.4 Sufficient slack shall be provided for equipment movement.

7.2.5 All cabling shall be secured and protected as necessary to the satisfaction of the Contract Administrator.

7.2.6 All electrical cables shall meet the requirements of the Canadian Electrical Code and shall be acceptable to the Ontario Electrical Safety Authority (ESA).

7.2.7 All wiring and connectors shall conform to industry standards.

7.2.8 Termination of data cabling shall be in accordance with the camera vendor's requirements.

7.2.9 The video interconnect cable required to connect the camera and communications equipment shall be routed from the dome camera to the controller cabinet in which the communications equipment is housed.

7.2.10 The dome camera control cables shall be terminated as per the guidelines provided in the installation manual.

7.3 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.1.1.1	√		
5.1.1.2	√		
5.1.1.3	√		
5.1.1.4	√		
5.1.1.5	√		
5.1.1.6	√	√	
5.1.1.7	√	√	
5.1.1.8	√	√	√

CLAUSE	PIT	POP	SIT
5.1.1.9	√	√	
5.1.1.10	√	√	
5.1.1.11	√	√	
5.1.1.22			√
5.1.3.1	√	√	
5.1.3.2	√	√	
5.1.3.3	√	√	√

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of dome cameras is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except for SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>VARIABLE MESSAGE SIGNS</u> - Item No.

Special Provision No. 685S01 July 2009

1. SCOPE

This Special Provision covers the requirements for the design, installation and testing of colour full matrix variable message signs (VMS), VMS controllers, and all associated equipment.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Ontario Provincial Standard Specifications, Construction:

OPSS 609	Grounding
OPSS 915	Construction Specification for Sign Support Structures

Ontario Ministry of Transportation Publications:

Designated Sources of Material (DSM)

Canadian Standards Association:

CAN/CSA-S6-06	Canadian Highway Bridge Design Code
CSA C22.2 No. 65-03	Wire Connectors
CSA C22.2 No.75-M1983	Thermoplastic-Insulated Wires and Cables
CSA C22.2 No. 35-M1987	Extra-Low-Voltage Control Circuit Cables, Low-Energy Control Cable, and Extra-Low-Voltage Control Cable
CSA Electrical Bulletin No. 561A	Electrical Insulation Tapes

Electronic Industries Alliance / Telecommunications Industry Association:

EIA/TIA-232-E	Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Binary Data Interchange
TIA/EIA-422-B	Electrical Characteristics of Balanced Voltage Digital Interface Circuits
TIA/EIA-568-B	Commercial Building Wiring Standard
EIA-310-D	Cabinets, Racks, Panels and Associated Equipment

Institute of Electrical and Electronics Engineers:

IEEE 518	Guide for the Installation of Electrical Equipment to Minimize Electrical Noise; Inputs to Controllers from External Sources
IEEE 802.3	IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications

International Organisation for Standardization:

ISO/IEC 17025	General Requirements for Competence of Testing and Calibration Laboratories – Standards Council of Canada

National Electrical Manufacturers Association (NEMA):

NEMA 250	Enclosures for Electrical Equipment (1000 Volts Maximum) - NEMA 3R
NEMA TS 4-2005	Hardware Standards for Dynamic Message Signs (DMS) with NTCIP Requirements

Others:

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

Display Module: means a matrix of pixels. A matrix of display modules are used to make up the display area of the sign face. A display module is typically a size that can be managed by maintenance staff when display modules need to be replaced. Typical modules sizes include 14 rows of pixels vertically by 10 columns of pixels horizontally or 9 rows of pixels vertically by 15 columns of pixels horizontally.

ITS: means Intelligent Transportation Systems

MIBs: means Management Information Base

MTBF: means Mean Time Between Failures.

Pixel: means an assembly of LEDs that collectively form an image-forming unit. All LEDs in a pixel are turned on or off in unison.

VMS: means Variable Message Sign that includes sign structure, signcase, display elements, photocell sensor, VMS controller, and all other associated mechanisms and equipment required to form an operational display.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Design Requirements

4.1.1 VMS Design

4.1.1.1 The structural design for the signcase, including the load on the sign face and mounting hardware, shall comply with all relevant requirements of CAN/CSA-S6.

4.1.1.2 Design of the variable message sign with all internal components shall sustain the galloping, vortex shedding, natural wind gust and truck-induced wind gust loading based on the appropriate design standards.

4.1.1.3 Design of the VMS shall meet all appropriate ice loading design standards.

4.1.1.4 The structural design of the sign and the associated mounting, undertaken by the Contractor, shall be compatible with the design of the sign support structure. The signcase shall be designed as an integral part of the mounting truss as shown in the Contract Drawings.

4.1.1.5 The structural design of the Ontario Trillium Sign Tab and the associated mounting, undertaken by the Contractor, shall be compatible with the design of the signcase. The Sign Tab shall be designed as an integral part of the sign case as shown in the Contract Drawings. The Owner will supply the Ontario Trillium Tab Sign.

4.1.1.6 All structural design components (including all mass calculations) shall have the design attested to by an Engineer.

4.1.1.7 The catwalk to the signcase along the support structure shall be compatible with the entrance to the signcase. The catwalk shall be provided on the right-hand shoulder side of the support structure to allow access from the shoulder to the signcase unless otherwise indicated on the Contract drawings.

4.1.1.8 The catwalk shall include a hand rail for safety purposes. The handrail shall be continuous around the exposed perimeter of the catwalk, except for an opening for maintenance access. Safety points shall be included along the catwalk to serve as anchor points for the maintenance workers to clip their safety harness to as they cross the catwalk.

4.1.2 Software Design

4.1.2.1 The Contractor shall submit a software development plan, schedule and software architecture (high level) design to the Contract Administrator for review.

4.1.2.1 Software documentation, as required, shall be submitted for review and approval to the Contract Administrator in advance of site installation of the VMS.

4.2 Submission Requirements

4.2.1 Shop Drawings

The Contractor shall submit all designs, drawings and details to the Contract Administrator for review. The Contractor shall submit shop drawings for the following:

a) Signcase and sign face;
b) Access door, maintenance walkway (catwalk) and safety rails;
c) Light emitting assembly;
d) Display matrix including mounting details;
e) Environmental system;
f) Mounting hardware and details;
g) Photosensor system and dimming scheme;
h) Driver electronics;
i) Interconnection method; and
j) Associated cables and wiring.

Shop drawings relating to the VMS controller shall consist of:

- circuit schematics;

- functional block diagrams;
- relevant timing diagrams;
- equipment sizes;
- catalogue numbers and cut sheets; and,
- other relevant material necessary to fully describe the controller.

4.2.2 Pixel

As a minimum, the following design information for the pixel shall be submitted to the Contract Administrator prior to the manufacturing of the sign:

a) Type and characteristics of LEDs and other major components of the pixel, as appropriate.
b) Design of the pixels and associated calculations to verify how the optical and colour performance requirements are achieved.
c) The range of driving parameters of the light emitting elements to attain the required range of design output intensity.
d) The reliability information of the LEDs and pixels including predicted MTBF for the LEDs and pixels for continuous operations under the worst case operating conditions and the associated reliability information from the LED manufacturer to show the LED MTBF with respect to operating temperature.
e) Degradation characteristics of the pixel with respect to light output, colour shift, light propagation and reflective characteristics shall be minimal.
f) Evidence and / or certification of the LED manufacturer's binning process.

4.2.3 Other Submission Requirements

The following additional design and construction elements shall be submitted prior to the manufacturing of the sign:

4.2.3.1 A sample of the exterior signcase paint finish.

4.2.3.2 The proposed method for replacing modules, wiring and internal components within the signcase. A mock-up of the polycarbonate sheet sections shall be visually demonstrated to the Contract Administrator.

4.2.3.3 The design verification for the control of negative (out-forward) pressure for the sign face shall be carried out as specified by CAN/CSA-S6 and certified by an Engineer. Methods to control the negative pressure shall be submitted with the sign documentation.

4.2.3.4 The Contractor shall submit calculations for the estimation of the mass of the signcase and the total mass of the sign (signcase complete with all internal components).

4.2.3.5 The Contractor shall submit the design criteria used and the associated design calculations and drawings to the Contract Administrator prior to the manufacturing of the sign.

4.2.3.6 Calculations for energy consumption to demonstrate that the limits for power consumption are met.

4.2.3.7 Design of the environmental system shall be submitted. The submission shall state the predicted internal environmental conditions during normal operations and under the external environmental extremes. The predicted maximum temperature adjacent to the light source shall be provided. Associated heat analysis calculations shall be attested by an Engineer.

4.2.3.8 Proposed display module driver mounting and maintenance access scheme.

4.2.4 Module Prototype Requirement

4.2.4.1 The Contractor shall construct and test a sign prototype consisting of a minimum of two fully functional display modules (including the polycarbonate sheet and mask) prior to fabrication of the sign to demonstrate compliance of the sign design with the requirements included in this Special Provision.

4.2.4.2 The prototype shall be of identical material and design of the sign to be supplied under the Contract.

5. MATERIALS

5.1 Previous Suppliers

The following companies have supplied monochrome (amber) type LED VMS to the Owner in the past:

a) Ledstar Inc.
131 Westcreek Dr.
Woodbridge, Ontario L4L 9N6
Telephone: (905) 265-7800

b) Daktronics Canada
1130 Rue Levis, Unit 4
Lachenaie, Quebec J6W 5S6
Telephone: (450) 492-1003

5.2 Signcase

5.2.1 The signcase shall be constructed of aluminum alloy or other approved non-ferrous, durable materials. The signcase shall provide the required protection and mechanical strength for the application.

5.2.2 The Signcase shall be designed to conform to the requirements of NEMA 3R outdoor enclosures.

5.2.3 The total mass of the sign component, including all internal and external components and the Ontario Trillium sign tab, shall not exceed 4,850 kg.

5.2.4 The outside dimensions, excluding the Ontario Trillium sign tab, shall be as specified elsewhere in the Contract Documents.

5.2.5 The Ontario Trillium Sign tab, supplied by the Owner, is shown as part of the Contract Drawings. The Contractor shall provide the appropriate mounting and mounting hardware for the sign tab to the signcase as per the Contract Drawings.

5.2.6 The perimeter of the signcase shall include a 75mm wide strip of high intensity retro-reflective fluorescent sign material, matching as closely as possible the amber colour ‘traffic yellow’.

5.2.7 All structural hardware components shall be stainless steel unless otherwise specified. Nylon stop nuts shall be used. The hardware components shall prevent galvanic action, corrosion, and loosening under the conditions of the highway environment. All fasteners of less than 3 mm diameter shall use Robertson heads and all larger fasteners shall use hex heads.

5.2.8 The signcase seams shall be continuous welded. Seams shall be welded with gas metal arc (MIG) or gas tungsten arc (TIG) process using bare aluminum welding electrodes. Spot welding shall not be used. Corrosion protection shall be provided between dissimilar metals.

5.2.9 The sign shall be supplied with a minimum of two (2) lifting eyes to facilitate lifting of the sign without damage.

5.2.10 The Signcase shall be designed such that the signcase support is provided at the truss panel points or as approved by the Contract Administrator.

5.2.11 Colour shall be grey on all exterior surfaces except for the front face. The signcase shall be cleaned, treated with chemical conversion coating, or with a paint primer suitable to the signcase material, and finished with two coats of prime quality enamel. Alternatively, anodized aluminum or electrostatically applied powder coats are acceptable. The finish shall be of prime quality substantially free of flow lines, paint washout, streaks, blisters and other defects that would impair serviceability or detract from the general appearance. All visible surfaces on the front face shall be entirely matt black except for the high-intensity retro-reflective fluorescent border strip.

5.2.12 Walk-in maintenance access is to be compatible with the design of the sign support structure and the maximum dimensions of the sign.

5.2.13 The design shall permit easy access to modules, wiring and internal components for maintenance and diagnostic purposes from within the signcase. Modules shall be provided with a swing-down assembly such that all equipment can be inspected, removed, and replaced.

5.2.14 The minimum overhead clearance in a walk-in signcase for the internal walkway shall be 1850 mm.

5.2.15 The signcase walk-in maintenance access door shall be constructed on the right or left end of the sign as shown in the Contract Drawings. The door shall be a minimum of 597 mm in width and 1524 mm in height. A three-point latching mechanism shall secure the door. All signcase walk-in maintenance access door locks on all signs provided under this Contract shall be keyed alike. Two keys for each sign shall be provided to the Contract Administrator upon completion of the project.

5.2.16 Safety strips shall be mounted on the interior signcase ceiling and on all interior protruding members.

5.2.17 The internal maintenance walkway shall extend along the entire length of the signcase. Minimum walkway width shall be 508 mm. Obstructions in the walkway path shall be minimized. The walkway shall be constructed of a non-slip material.

5.2.18 The signcase shall be completely enclosed to prevent any tools from falling onto the roadway below during maintenance and repair activities.

5.2.19 The LED module section of the VMS shall be sectioned off from the general interior of the sign by means of sliding panels made of aluminum.

5.3 Sign Face

5.3.1 The sign face shall be protected by weather tight, dust proof, non-glare polycarbonate sheets. The polycarbonate sheeting shall be secured to the signcase as recommended by the manufacturer of the polycarbonate sheet and shall be designed with appropriate methods to withstand all applicable loads as required by CAN/CSA-S6. An aperture mask shall be provided in front of the polycarbonate sheets and shall be sized and positioned to accommodate the luminance and colour output requirements of the sign.

5.3.2 The sections of polycarbonate sheets shall be securely mounted to the front face of the sign. The protective screen shall be rigid and shall not deform as a result of wind or temperature.

5.3.3 Suitable segments and/or measures shall be provided to allow for the expansion and Contraction of the polycarbonate sheets. They shall be positioned, aligned and sized such that they do not block the pixels.

5.3.4 The signcase shall be designed to allow cleaning of the internal surface of the polycarbonate sheets.

5.3.5 The polycarbonate sheets shall exhibit a consistent degree of uniformity from one panel to another and across the entire sign face.

5.3.6 While the type and material selected for the polycarbonate sheets shall satisfy the requirements to protect the sign, the design of the polycarbonate sheets shall also be required to meet the overall optical performance of the sign display as stated herein.

5.3.7 The sign face including polycarbonate sheets and segments shall be appropriately sealed to prevent the ingress of moisture and debris and shall accommodate the required expansion and contraction.

5.4 Sign Display Matrix

5.4.1 The display shall be full matrix, as shown in the Contract Drawings.

5.4.2 The full matrix display shall have visible 70 rows and 360 columns of pixels. In the case of a display module that is 14 rows by 10 columns, the full matrix would consist of 180 display modules arranged in 5 horizontal rows and 36 vertical columns. In the case of a display module that is 9 rows by 15 columns, the full matrix would consist of 192 display modules arranged in 8 horizontal rows by 24 vertical columns (ie. the top and bottom row of pixels of the full sign display are not visible). The dimensions of the visible display area opening and border areas around the sign display area shall be constrained to the dimensions shown on the Contract drawings.

5.5 Sign Power Requirements

5.5.1 The power consumption shall not exceed 7.5 kVA with all fans, heaters, auxiliary equipment and 25% of the pixels operative in their maximum output setting for the colour white.

5.5.2 The power factor shall be a minimum of 0.90. The Contractor shall provide power factor correction equipment, where necessary, to achieve this minimum power factor.

5.5.3 Two (2) duplex 110V receptacles with a ground fault interrupter (GFI) shall be provided inside the signcase for the use by maintenance personnel. The receptacles shall be easily accessible by the maintenance personnel.

5.5.4 Fluorescent tube lighting shall be installed inside the signcase to provide lighting during maintenance and repair activities. Control of the lighting shall be through a switch located within the signcase close to the maintenance access door.

5.6 Sign Display

5.6.1 General Display Properties

5.6.1.1 The sign display shall be light emitting type employing light emitting diode (LED) technology.

5.6.1.2 The Contrast Ratio requirements shall be as defined and specified within Section 5.2 of NEMA TS 4-2005.

5.6.1.3 The Cone of Vision Type Classification of the display shall be type class “b” as defined and specified within Section 5.3 of NEMA TS 4-2005.

5.6.1.4 The Luminance Intensity requirements shall be as defined and specified within Section 5.4 of NEMA TS 4-2005.

5.6.1.5 The Chromaticity Classifications and Limits requirement shall be as defined and specified within Section 5.5 of NEMA TS 4-2005.

5.6.1.6 The Moving Arrows requirements shall be as defined and specified within Section 5.8 of NEMA TS 4-2005.

5.6.1.7 The Test Parameters and Test Areas defined within Sections 5.9.1 and 5.9.2 of NEMA TS 4-2005 shall be used in the performance of all tests to verify and certify the optical, photometric, and colorimetric properties of the sign display.

5.6.1.8 Failure of a pixel or display module shall not cause failure of any other pixel or module. Failure of a single LED within a pixel shall not cause a failure of the pixel nor the loss of more than 25% of the pixel’s intensity. Failure of LEDs for a single colour within a pixel shall be deemed a pixel failure.

5.6.1.9 When pixels are operating in a pulse mode, no noticeable light flicker shall be visible by a human eye. The frequency of the pulse mode shall be minimum 90 Hz.

5.6.1.10 The sign display for all colours individually and combination of colours shall be clearly legible from a distance of between 75 m and 300 m under normal highway operating conditions from any part of the approaching lanes including the shoulders.

5.6.1.11 The sign display for all colours individually and combination of colours shall be visible from a distance of 500 m in all ambient light conditions.

5.6.1.12 The sign face shall be set at an angle of 3^o (degrees) from vertical so that the pixels are aimed downward towards the roadway.

5.6.2 Display Module

5.6.2.1 Each display module shall be sized to be easily handled for maintenance operations and be made up of multiple pixels arranged in regular horizontal rows and vertical columns with pixel centres equivalently spaced. Acceptable configuration sizes of the modules shall be either 14 rows by 10 columns for the 33mm pixels or 9 rows by 15 columns for the 34mm pixel.

5.6.2.2 Within the display module, each pixel shall be individually addressable to allow full colour, full graphics and proportional fonts capability with variable levels of luminous intensity.

5.6.2.3 The spacing between pixels shall be no less than 33 mm and no greater than 34 mm as measured from the centre of one pixel to the centre of adjacent pixels both horizontally and vertically. The horizontal and vertical spacing shall be equal. The above constraint is for the 14 by 10 and 9 by 15 pixel modules respectively.

5.6.2.4 Each display module shall be mounted and secured such that maintenance staff can easily remove the display module. All display modules within a single sign shall be the same size.

5.6.3 Pixels

5.6.3.1 The pixels shall be made up of a mix of the primary colour - Red, Green and Blue - LEDs as a minimum. Other non-primary colours will be considered if required to meet the color and luminance intensity requirements of the display. The luminance intensity of the pixel shall meet or exceed the luminance intensity requirements of Section 5.4 within NEMA TS 4-2005. The chromaticity limits and classifications of the pixel shall meet the requirements of Section 5.5 within NEMA TS 4-2005.

5.6.3.2 Each pixel shall be comprised of sufficient light emitting diodes (LEDs) to meet the optical requirements of this special provision while driving each LED sufficiently under the LED maximum limits to satisfy the end life and mean time between failures (MTBF) as specified elsewhere in this special provision. When turned on and viewed from 75 m, the pixel shall be visible as a solid dot and not as individual LEDs for all colours individually and combination of colours. The pixel shall not require external or supplementary illumination. Operation of each pixel shall be independent of the other elements such that failure of a pixel will not affect proper operations of the other elements.

5.6.3.3 All pixels of the sign shall be of identical material and design to ensure uniformity in characteristics. Design of the pixels shall meet the harsh environmental requirements of the intended installation within the component manufacturer's rated temperature range and operating characteristics.

5.6.3.4 The pixels shall be assembled in display modules to facilitate maintenance and replacement.

5.6.3.5 When activated, pixels shall be able to display 24Bit RGB colour as defined in Section 5.5 of NEMA TS 4-2005. When not activated, pixels shall be non-light emitting.

5.6.3.6 All pixels shall be securely mounted such that the nominal axis of the light output shall be perpendicular to the sign face and centred within the mask opening of the sign face..

5.6.3.7 The average luminance output from the highest 12% of the pixels to the lowest 12% shall be less than 3:1 for all colours individually and combination of colours. The ratio of the average luminance output from the highest 4% of the pixels to the lowest 4% shall be less than 5:1. The average luminance output from the left 12% of the pixels to the right 12% shall be less than 3:1 for all colours individually and combination of colours. The ratio of the average luminance output from the left 4% of the pixels to the right 4% shall be less than 5:1.

5.6.3.8 The pixel design shall be such that it minimizes the effect of heat build up within the pixel. The LEDs shall operate within the LED manufacturer rated temperature range under the worst case operating conditions while still maintaining the targeted end life and mean time between failures (MTBF) as specified elsewhere in this specification.

5.6.3.9 Each pixel shall contain sufficient LEDs, such that the entire sign with the polycarbonate sheet and mask in front of the pixels shall fulfil the optical output, contrast, viewing angle, legibility and reliability requirements as specified elsewhere in this Special Provision.

5.6.3.10 The soldering of the LEDs shall be in accordance with the manufacturer's recommended guidelines.

5.6.4 LEDs

5.6.4.1 The Contractor shall choose the LED technology for each LED colour such that the desired luminance intensities, chromaticity limits and de-rated LED driving requirements are achieved while satisfying the end life and mean time between failures (MTBF) specified elsewhere in this specification.

5.6.4.2 All LEDs of the same colour shall be of industrial grade and of identical make and model from the same manufacturer.

5.6.4.3 The LED shall be highly reliable for the intended applications. With a target continuous operating period of five (5) years, the mean time between failure (MTBF) of a single LED shall not be less than 150,000 hours at the brightest level and with all the pixels activated within the maximum LED driving characteristics for the maximum design output for the sign operations at an outside air temperature of 35^{o} C and a relative humidity range of 5% to 100%. Failure of a pixel is defined as the inability to activate more than 25% of the LEDs in a pixel and/or achieving less than 25% of the intended pixel output intensity and/or failure of the LEDs for a single colour within a pixel.

5.6.5 Display Font

The sign shall display the fonts MTO1 and MTO2 as detailed in the Contract Drawings.

5.6.6 Display Performance

The time to display a 75 alphanumeric character message generated at the VMS controller shall not exceed 0.5 second from a blank state.

The time to display a graphic generated at the VMS controller shall not exceed 0.5 second from a blank state.

5.7 Sign Photosensor System

The sign shall have three photovoltaic sensors. One sensor (cell 1) shall be aimed in the northerly direction (away from nearby lights) and scaled for a reading of up to 100 lux (horizon type). The other two sensors (cells 2 and 3) shall be aimed in opposite directions and perpendicular to the sign face. These two sensors shall be scaled for a reading of up to 100,000 lux. The sensors shall be mounted on the top of the signcase near the right side for ease of maintenance. The aiming angle of the sensors shall be adjustable:

a) Cell 1 - Northern sky;
b) Cell 2 - Facing towards oncoming traffic (upstream); and
c) Cell 3 - Facing towards passed traffic (downstream).

5.8 Sign Environmental System

5.8.1 The sign enclosure and the equipment housed within shall be protected from moisture, rain, snow, sun radiation, dust, dirt and salt corrosion found in a highway environment.

5.8.2 A heating system and thermal insulation shall be provided, if required, to prevent adverse effect on the equipment due to condensation. Condensation may be controlled using thermostatically controlled strip heaters or axial fan heaters inside the sign face.

5.8.3 A forced ventilation system shall be provided, if required, to mitigate the effects of dust ingress and for providing air movement, thermal cooling, and thermal equalization to mitigate the accumulation of condensation and formation of “hot spots”. All fans shall be mounted in the top of the sign case. All forced intake air shall be filtered.

5.8.4 The environmental system shall maintain the internal environment of the sign within the operating range of all internal components, - 40^{o} C to + 65^{o} C, being employed for the design of the sign system for all external conditions encountered in Ontario.

5.8.5 The environmental system shall be designed for proper continuous sign operations at 25% of the pixels with all possible pixel combinations for LED technology, at the brightest level, under the full external environmental range.

5.8.6 An adequate quantity of temperature sensors shall be provided inside the signcase with associated temperature monitoring functions to prevent damage of the components due to build-up of excessive heat.

5.8.7 The use of fans is required to provide comfortable working conditions within the sign during maintenance activities. When not in use, the fan openings shall be shut and turned off.

5.8.8 Liquid coolants shall not be permitted.

5.9 Sign Electronic Components/Electrical Components

5.9.1 The requirements of Section 8.2 - Components of NEMA TS 4-2005 shall apply to this work.

5.9.2 The requirements of Section 8.2.1 of NEMA TS 4-2005 shall apply to this work and is amended with the addition of the following.

All electrical/electronic components shall be of modular, interchangeable, plug-in type fabrication and shall be standard manufacturer’s components and CSA certified, where possible. Failure of a single display pixel or module shall not affect operations of the other display pixels or modules. During replacement of defective driver boards or light emitting modules the sign shall remain operational.

5.9.3 The requirements of Sections 8.2.2 to 8.2.13 of NEMA TS 4-2005 shall apply to this work. Section 8.2.2.1 is deleted and replaced with the following.

Electronic components shall not be socket or jack mounted, except for LSICs (Large Scale Integrated Circuits) having 16 or more leads. If IC sockets are used, they shall have high grade, industrial quality, machined pin contacts and dual spring, gold plated type sockets.

5.9.4 The requirements of Sections 8.3 and 8.4 of NEMA TS 4-2005 shall apply to the work.

5.9.5 All components shall be capable of withstanding the extreme environmental conditions as specified without degrading their design life. The design shall be inherently temperature compensated to prevent abnormal operation. Circuit designs shall include compensation as is necessary to overcome adverse effects due to temperature in the specified environmental range.

5.9.6 All components including the LEDs shall be de-rated by a minimum of 20% with regard to applied voltage, current, and power dissipation unless otherwise specified such that material shortening of life or shift in values is minimized.

5.10 Sign Cables and Wiring

5.10.1 The Contractor shall provide low voltage (power) and extra low voltage (internal sign control) cables necessary to operate the variable message signs.

5.10.2 Properly supported cable trays shall be provided for routing all wiring within the sign.

5.10.3 Low voltage (power) cables shall be stranded copper type TWH meeting the requirements of the latest CSA Standard C22.2 No. 75.

5.10.4 Extra low voltage (internal sign control) cables shall be type ELC meeting the requirements of the latest CSA standards C22.2 No. 35.

5.10.5 All cables shall be protected against lightning or over-voltage conditions with appropriate surge protectors. The low voltage circuits shall be protected by MOVs rated at 20 kA with a peak voltage of 350 volts.

5.11 Sign Connectors

5.11.1 Wire connectors shall be of the fork tongue compression type for terminal connections or the insulated wing nut vibration proof spring type for wire-to-wire connections and shall meet the requirements of the latest CSA standard C22.2 No. 65.

5.11.2 The signcase shall include a fibre connector suitable for connecting the interconnecting fibre cable to the VMS controller.

5.11.3 All connectors shall have suitable strain relief and positive retention.

5.12 Sign Grounding Materials

Grounding wire and connectors shall meet the requirements of OPSS 609.

5.13 Sign Driving Circuitry

5.13.1 Driver boards shall be mounted to the back of each display module.

5.13.2 Each driver board shall be uniquely addressable.

5.14 Sign Mounting Hardware

5.14.1 All assemblies within the signcase shall be mounted using shock, vibration and weather resistant hardware.

5.14.2 The sign structure shall be secured to the sign support structure as shown in the Contract Drawings.

5.15 VMS Controller

5.15.1 General

5.15.1.1 The VMS controller shall support the NTCIP functionality and protocols as specified elsewhere in the Contract Documents. Full and exhaustive compliance testing of the NTCIP protocols and functionality shall be required.

5.15.1.2 The VMS controller shall be a microprocessor based unit.

5.15.1.3 A watchdog timer for detecting controller failure and resetting the microprocessor shall be provided.

5.15.1.4 The VMS controller’s front panel shall include a keypad and LCD. The device shall be used to perform the following functions with the sign controller and VMS:

a) Monitor the current status of the sign controller, including the status and representation of the message visible on the display face;

b) Perform diagnostics testing of various system components, including pixels, power systems, sensors, and more;
c) Activate messages stored in memory;
d) Configure display parameters, including display size and colors;
e) Configure communications port settings and NTCIP options.

5.15.1.5 The front panel interface shall also include the following:

a) Power switch to turn the controller on and off;
b) LED power "on" indicator;
c) "Local/remote" switch that places the controller in local mode such that it can be controlled from the front panel interface;
d) LED to indicate state of the "local/remote" mode switch;
e) Reset switch to quickly restart the controller.

5.15.1.6 All indicators shall have a +/- 45^{o} cone of visibility with the axis perpendicular to the front panel. All indicators shall be readily visible at a radius of up to 1.22 metres within the cone of visibility.

5.15.1.7 The VMS controller shall be capable of communicating with a local field test computer and centrally located master controller.

5.15.1.8 The VMS controller unit shall support two forms of communication interface: Serial and Ethernet. The controller shall also support a fibre connection to the VMS signcase.

5.15.1.9 The controller communications shall be user selectable.

5.15.1.10 The controller shall have a unique address for communication with the VMS master controller. This address shall be stored in non-volatile memory/solid state disk.

5.15.2 Environmental

The controller shall be capable of operating over the temperature range of - 30^{o}C to + 65^{o}C.

5.15.3 Electrical Requirements

5.15.3.1 The VMS controller shall operate from a line voltage of 106 to 126 Volts AC and frequency of 60 +/- 0.5 Hertz.

5.15.3.2 The power consumption of the VMS controller, power supply, and permanently connected equipment shall not exceed 250 watts total.

5.15.3.3 All components, when housed in the controller chassis, shall be unaffected by transient voltages normally experienced on commercial power lines.

5.15.3.4 All equipment shall be capable of normal operation following opening and closing of contacts in series with the applied voltage to the cabinet at a rate of 30 openings and closings per minute for a period of 2 minutes in duration.

5.15.3.5 All electrical modules within the controller assembly shall fully comply with local governmental requirements concerning the suppression of unintended radio frequency emissions.

5.15.3.6 All circuits shall be sufficiently protected against stray static electricity so as not to be damaged during normal shipping, handling and operation.

5.15.3.7 The controller shall include appropriately sized lightning protection and surge protection. The protective devices shall be encapsulated hybrid suppressors and shall be bayonet mounted such that replacement can be done without removal of the housing or other equipment. The suppressors shall be EDCO Cat. # PC-642 or approved equal.

5.15.3.8 The general principles of minimizing the effects of voltage surges shall conform to the requirements of IEEE Standard 518-1982.

5.15.3.9 All fuses shall be easily accessible on the front panel unless otherwise specified and shall be replaceable without the use of any tools.

5.15.3.10 Test points shall be provided for monitoring all power supply voltages. All test points shall be readily accessible when equipment is opened in service position and the voltage level to be verified shall be clearly labelled beside the test point.

5.15.3.11 The power supply, if separate from the controller enclosure, shall be EIA rack mountable.

5.15.3.12 The power cable shall be easily detached from the controller for quick removal.

5.15.4 Communications

5.15.4.1 Serial

5.15.4.1.1 The controller shall be provided with two EIA/TIA-232-E serial communications ports for use with a plug-in field computer and for communications with the data modem.

5.15.4.1.2 The serial ports shall use a 9-pin socket connector; ITT DB-9S. The field test computer port shall be on the front face of the enclosure.

5.15.4.1.3 Communications through the serial ports shall be asynchronous in a half-duplex mode.

5.15.4.1.4 The standard baud rate shall be 9600 while allowing the selection of 9600 or 19200.

5.15.4.1.5 It shall be possible to easily switch from full-duplex to half- duplex and vice versa.

5.15.4.2 Ethernet

5.15.4.2.1 The controller shall be provided with one IEEE 802.3u 10/100Base-TX Ethernet port.

5.15.4.2.2 The Ethernet port shall have a RJ-45 female connector. The port shall meet Category 5 specifications and shall be compliant with EIA/TIA-568-B standard pin out.

5.15.4.3 Fibre Interconnect

The controller shall include an optical interface suitable for connecting the interconnecting fibre cable to the VMS signcase.

5.15.5 Storage

5.15.5.1 The controller shall have non-volatile electronically changeable memory. This memory shall be formed by flash or battery-backed static RAM integrated circuits 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.

5.15.5.2 The controller memory shall be capable of storing a minimum of 100 two page messages in non-volatile RAM.

5.15.5.3 The controller shall store a minimum of 100 graphic symbols in non-volatile RAM.

5.15.5.4 The controller shall support a minimum of four fonts and 255 characters shall be burned in the non-volatile memory.

5.15.6 Control of Display

5.15.6.1 The controller shall be able to display messages of up to 75 alphanumeric characters and graphic symbols with colour on the variable message sign as commanded by the VMS controller or from the plug-in terminal.

5.15.6.2 The controller shall have the capability of detecting display on/off state element failures. As a minimum, the following failure modes shall be reported:

a) A complete module fails;
b) A complete column of pixels fails;
c) A complete row of pixels fails;
d) More than 8% of all pixels fail; or
e) One or more of the photosensors fail.

5.15.7 Control of Sign Luminance

5.15.7.1 The controller shall provide means to change the brightness of the display matrix manually or automatically.

5.15.7.2 The manual intensity control will allow the user to select one of at least 15 intensity levels. The brightness shall remain at that level until the user changes the level or sets the controller to automatic mode.

5.15.7.3 The automatic intensity control mode shall monitor the ambient light sensors on the VMS and will use a mathematical algorithm to automatically select one of the 15 or more intensity levels.

5.15.7.4 The 15 automatic intensity control levels shall have five (5) ranges controlled by the prevailing outdoor illumination levels and software, and a minimum of three (3) levels within each of the five (5) ranges selected on the basis of message importance.

5.15.7.5 Sensing of ambient light levels shall be through the three VMS photosensors connected through an analogue to digital converter card using separate channels. The analogue-to-digital converter shall have a minimum resolution of eight bits and a multiplexer of four channels.

5.15.7.6 The controller shall be equipped with pulse width modulation (PWM) circuitry with the peak current not exceeding the de-rated forward current recommended by the LED manufacturer for the specified LED cluster and as further constrained by the life cycle and MTBF requirements specified elsewhere in this specification.

5.15.7.7 In the case of a critical photosensor system failure, the light output of the sign display elements shall be defaulted to the night range setting. Failure notification of photosensor failure, both locally and at central, shall, if the sensor is not a single unit, indicate which photosensor has failed.

5.15.8 Controller Software

The software for the VMS controller shall meet all of the functional requirements specified elsewhere in the Contract Documents.

5.15.9 Physical and Mechanical Requirements

5.15.9.1 The dimensions of the complete controller, including the power supply and all connectors, shall not exceed 775 mm high, 480 mm wide, and 530 mm deep.

5.15.9.2 The controller shall be EIA 480 mm rack mountable.

5.15.9.3 There shall be no serviceable parts within the controller.

5.15.9.4 All connectors shall be keyed to prevent accidental insertion of the wrong connector;

5.15.9.5 The design life of the controller and its components, under 24 hours a day operating conditions in their circuit application, shall not be less than ten years.

5.15.9.6 No internal item, component or subassembly shall emit a noise level exceeding the specification outlined by CSA C108.8-M1983.

5.15.9.7 All aluminum components shall be anodized. The anodic coating shall have a minimum thickness of 0.178 mm and a minimum coating weight of 42 grams per square metre. Prior to the anodic coating, the component shall be cleaned and etched.

5.15.9.8 The manufacturer's name or logo, model number, serial number, and circuit issue or revision number shall appear and be readily visible on all items supplied. All serial numbers shall be at least 3 mm in height and shall be either etched or engraved on all items supplied.

5.15.9.9 Different components of the controller equipment including all the wires, connectors, control LEDs, switches, etc. shall be identified with labels of engraved lamacoid or with permanent transfers. The identifiers shall correspond to the labels used in the equipment documentation and maintenance material.

5.16 Sign to Controller Interconnect Wiring

5.16.1 All interconnecting cables between the controller and the sign shall be fibre optic outdoor rated for installation in underground ducts or aerial on messenger cable. The cable shall include the number of fibres required for communication between VMS and the VMS controller plus two spare fibres. A tracer wire shall be provided either integral to the cable or external.

5.16.2 The fibre connectors shall match interface requirements. The spare pair of fibres shall be terminated on each panel in the signcase and controller cabinet with appropriate patch cords.

5.16.3 There shall be appropriate electronics to enable a laptop connection to the ground control cabinet's controller from within the signcase.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 Timing of Work

7.1.1 The Contractor shall ensure that sign controller units are installed, tested and ready for operation before installing the variable message signs.

7.1.2 All installation work shall be carried during permitted times for lane closures as specified elsewhere in the Contract.

7.1.3 The Contractor shall coordinate communication and central software configurations with the Owner. At least one month notice shall be provided by the Contractor to allow for any configuration work required by the Owner.

7.2 Sign Installation

7.2.1 The requirements of OPSS 915 shall apply to this work.

7.2.2 All mechanical hardware for initial attachment shall be attached and secured prior to the reopening of lanes to traffic. Attachment of all hardware shall be completed prior to the release of crane cables.

7.3 Controller Installation

7.3.1 The controller shall be installed in the designated space in the field cabinet in locations as indicated in the Contract Drawings.

7.3.2 Only Robertson head or combination of Robertson and slot head screws shall be used for mounting assemblies on the controller cabinet rack. Slotted thumbscrews may also be used for assembly mounting. All screw type fasteners shall utilize locking devices or locking compounds. All screws, nuts, and washers accessible to the maintenance staff shall be made of stainless steel.

7.3.3 All protective devices such as lightning arresters and surge protectors shall be mounted external to the VMS controller enclosure but within the cabinet.

7.3.4 All mounting hardware and wire connections shall be easily accessible and removable with hand tools.

7.3.5 The front panel and chassis shall be connected to the cabinet ground bus from a single point only.

7.4 Installation of Sign to Controller Interconnect Cables

7.4.1 The Contractor shall complete all wiring between the VMS signcase and VMS controller. The interconnect power and communications cables shall be installed in liquid tight conduit in inconspicuous locations, between the nipples on the sign support and the signcase. The interconnecting cables shall use the sign support beams and legs as raceways and shall be installed in continuous, unspliced lengths between the signcase and the controller cabinet. Sufficient slack shall be left to ensure that the connection to the power source will be possible without the need to add or splice any cables. Cables and connectors shall not be stressed during or after installation.

7.4.2 All fibre optic control cables shall be properly terminated on industry standard termination panels within the signcase and field cabinet with fibre optic patch cords used between the panel and all control equipment.

7.4.3 All fibre optic interconnection cables shall not exceed the minimum bending radius specified by the manufacturer.

7.4.4 All interconnection cables shall be installed inside two (2) ducts connecting the cabinet pad and the sign footing (see Contract Drawings).

7.4.5 Low-voltage cables and fibre optic cables installed in the cabinet shall be routed on opposite sides of the cabinet and shall not be routed parallel to other low-voltage cables.

7.4.6 All electrical installations shall meet the requirements of Ontario Electrical Safety Code.

7.5 Pre-delivery Repair

The procedures listed below shall be followed in the repair of equipment before shipment:

7.5.1 Any defects or deficiencies found by the inspection system involving mechanical structure or wiring shall be fed back through the manufacturing process or special repair process for correction.

7.5.2 Defects in printed circuit boards or electronic circuit components shall be specially treated as follows:

a) A printed circuit board may be flow soldered a second time if copper runs and joints are not satisfactorily coated on the first run;
b) Under no circumstances shall a printed circuit board be flow soldered more than twice;
c) Hand soldering may be used for printed circuit repair;
d) A printed circuit board may be factory repaired not more than two times during the warranty period. A third failure shall result in replacement of the printed circuit

board. A circuit board whose components or printed conductor become damaged during factory repair shall also be replaced by a new board; and

e) All factory repairs shall be described in detail on a form to be furnished by the Contract Administrator. The completed form shall be returned together with the repaired unit.

7.6 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
4.2.3.2	√		
4.2.4.1	√ [1]		
5.2.3	√		
5.2.4	√		
5.2.11	√ [2]		
5.3.3	√		
5.3.5	√ [3]		
5.3.7	√		
5.5.1	√		
5.5.3	√	√	
5.5.4	√	√	
5.6.1.2	√		
5.6.1.3	√		
5.6.1.4	√		
5.6.1.5	√ [3]		
5.6.1.6	√		
5.6.1.7	√		
5.6.1.8	√		
5.6.1.10	√ [4]	√ [4]	
5.6.1.11		√ [4]	
5.6.1.12		√	

CLAUSE	PIT	POP	SIT
5.6.2.2	√ [5]		
5.6.2.3	√		
5.6.3.1	√ [3]		
5.6.3.2	√		
5.6.3.5	√ [6,7,8]	√ [7,8]	
5.6.3.6	√		
5.6.3.7	√		
5.6.3.8	√ [9]		
5.6.3.9	√		
5.6.4.2	√		
5.6.5	√ [10]		
5.6.6	√	√	
5.8.4	√ [16]		
5.8.5	√ [11]		
5.9.2	√		
5.10.5	√	√	
5.15.1.1	√		
5.15.1.4	√		
5.15.1.5	√		
5.15.1.7	√ [12]	√ [12]	√ [12]
5.15.1.8	√ [13]	√ [13]	
5.15.1.9	√		
5.15.2	√ [14]		
5.15.3.2	√		
5.15.3.4	√ [15]		
5.15.4.1.1	√		
5.15.4.1.4	√	√	√
5.15.4.1.5	√		
5.15.4.2.1	√	√	√
5.15.5.1	√		
5.15.5.2	√		

CLAUSE	PIT	POP	SIT
5.15.5.3	√		
5.15.5.4	√		
5.15.6.1	√ [17]	√ [17]	√ [17]
5.15.6.2	√ [16]		
5.15.7.2	√	√	
5.15.7.3	√	√	
5.15.7.7	√		
5.16.3	√	√	

Testing Footnotes:

[1] i) Each prototype shall exhibit dimming functions as specified for the full size sign.

ii) Each prototype shall be equipped with a polycarbonate sheet cover including the intended aperture mask.

iii) Each prototype shall display the following test patterns:

a) All elements on;
b) Activation of alternate rows;
c) Letters A-to-Z and numerals 0 to 9; and
d) All elements off.

iv) The Contractor shall demonstrate to the Contract Administrator that the legibility distance, viewing angles, pixel intensity, dimming, spacing between pixels, uniformity of pixel intensity and contrast ratios, as defined in this Special Provision, are met.

v) All equipment shall continue normal operation when subjected to the low temperature test: With the item functioning at a line voltage of 106 VAC for all items in its intended operation, the ambient temperature shall be lowered from 20^{o} C to the minimum temperature defined for the signcase and controller at a rate of not more than 18^{o} C per hour. The item shall be cycled at this temperature for a period of five (5) hours and then returned to 20^{o} C at the same rate. The test shall be repeated with a line voltage of 126 VAC.

vi) All equipment shall continue normal operation when subjected to the high temperature test: With the item functioning at a line voltage of 106 VAC in its intended operation, the ambient temperature shall be raised from 20^{o} C to the maximum temperature defined for the signcase and controller at a rate of no more than 18^{o} C per hour. The item shall be cycled at this temperature for five (5) hours and then returned to 20^{o} C at the same rate. The test shall be repeated with the line voltage of 126 VAC.

[2] The Contractor shall demonstrate that the Signcase shall suffer no coating loss by the following method: Two samples of 100 mm x 200 mm, made of the same material and coating as the Signcase supplied, shall be used for the test. Two 225 mm diagonal scratches exposing bare metal will be made

on a sample. It will be soaked in de-mineralized water for 192 hours. A 25 mm strip of masking tape shall be tightly affixed to this surface and removed with one quick motion; evidence of blistering, softening or peeling of the paint and/or coating from the base metal shall be cause for rejection.

3 Subjective assessment of colour uniformity.

4 Visibility tests including test drives during day and night conditions to verify the legibility distance. Testing at dawn or sunset will be required depending on site location. Pixel luminance shall vary automatically during the tests and be supplemented with manual input.

5 All the display modules shall be turned on and off several times to demonstrate that all driving circuitry and/or multiplexing circuitry is functional.

6 Demonstration of all pixels activated/deactivated in alternating mode using a checkerboard test pattern for 30 minutes minimum.

7 Demonstration of operation with the VMS controller, including demonstration of the use of all software commands capable of controlling the pixels on/off state.

8 Continuous operation over 168 hours using a message display change every 15 minutes. Any pixel failures during this test will require satisfactory repeat of the complete test. Demonstration of various pixel luminance levels, set and operating in accordance with the specifications, is required. The signcase shall not be covered during this operation.

9 The LED pixels shall be tested to ensure suitability for the application. As a minimum, the LED pixels shall pass the following test:

a) A random sample of not less than 200 pixels shall be activated continuously at the brightest design output level at the predicted maximum temperature adjacent to LED pixels inside the signcase. The duration of the test shall be sufficient to verify satisfactory operation of all pixels to simulate a total pixel operation of not less than 150,000 hours. The test shall be considered as failed upon any single failure of the pixel in the test sample.

b) Prior to the manufacturing of the sign, the Contractor shall provide proof of certified testing by the manufacturer or conduct the above test to the satisfaction of the Contract Administrator. The Contractor is responsible for any re-test or design modification of the pixel to satisfy the above test criteria.

10 Downloading of messages with and without graphic symbols shall be carried out using all variations of attributes or other variables. Recovery of all messages and graphic symbols from the appropriate memory slots shall be demonstrated at least three (3) times.

11 Demonstration of the maximum internal signcase temperature for proper operation of the equipment inside the signcase. Measurements shall be conducted with the sign displaying a test pattern defined by the Contract Administrator. A minimum of 10 test points identified by the Contract Administrator shall be measured. The temperature shall be measured when the internal environment of the signcase reaches a steady state. The maximum internal signcase temperature shall be verified with respect to the specification with necessary adjustment for the worst-case ambient conditions. If the maximum internal signcase temperature as identified in the test exceeds the predicted temperature as identified in the specification, the test for pixels as specified in the specification shall be repeated to verify that

the reliability requirements of the pixels are met. The Contractor is responsible for any re-test or design modification to satisfy the test criteria.

12 The Contractor shall demonstrate proper controller operation with the communication subsystem and master controller by downloading and uploading the message library and by demonstrating that all software commands, as embedded in the communications protocol, are functional. The field test computer may be used for master emulation. The Owner shall provide the simulated central software for the purpose of testing. A laptop shall be used to initiate all commands required in the software specifications. The controller must respond correctly within 30 seconds of issuing the command and must transmit the correct reply. All commands shall be held for a minimum of 15 minutes.

13 The controller, when subjected to a loss of communication, shall resume operation with the VMS displaying a blank message.

14 All controller environmental tests to be carried out by the Contractor shall employ the services of an accredited testing laboratory in compliance with ISO/IEC 17025 (general requirements for competence of testing and calibration laboratories) Standards Council of Canada. The controller unit shall be submitted to a low temperature test by cooling to – 10^{o} C for 24 hours and then demonstrating reaction to commands as in tests above. The controller unit shall then be de-energized for 30 minutes and then re-powered and the tests performed again.

15 The controller, when subjected to a loss of power, shall resume operation with the VMS displaying a blank message.

16 All subassemblies (including all electronic components mounted in the sign) shall be environmentally tested for a minimum of 24 hours by cycling over the full operating temperature range of the equipment prior to installation in the signs.

17 The Contractor shall demonstrate that the controller unit turns all sign display modules on and off by calling up test patterns from the local field test computer and central master controller.

8. QUALITY ASSURANCE

The Owner or Contract Administrator shall be provided the opportunity to perform quality assurance testing including, but not be limited to, the following:

a) Tests of sign display visibility under various ambient conditions;
b) Measurement of pixel luminance;
c) Testing of maintenance accessibility features;
d) Testing of redundancy features;
e) Testing of trial messages by transmission from the VMS Master Controller;
f) Systems integration tests with the Communications and VMS Master Controller subsystems;
g) Quality inspection of all fabricated items;
h) Testing on site with a field test computer (locally).

9. MEASUREMENT FOR PAYMENT

Measurement for payment of the number of variable message signs is by Plan Quantity as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including manufacturing, delivery, installation, testing and the production of all drawings, text and test results, except for SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>PORTABLE VARIABLE MESSAGE SIGNS, TRAILER MOUNTED</u> - Item No.

Special Provision No. 685S06 September 2007

1. SCOPE

This Special Provision covers the requirements for delivery, installation, documentation and testing of trailer mounted Portable Variable Message Signs (PVMS).

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Canadian Standards Association:

CAN/CSA-S6-00 Canadian Highway Bridge Design Code

National Electrical Manufacturers Association (NEMA):

NEMA 250: 2003 Enclosures for Electrical Equipment (1000 Volts Maximum) - NEMA Type 3R

Highway Traffic Act R.R.O. 1990:

Ontario Regulation 618 Specifications and Standards for Trailer Couplings

Transport Canada:

Canada Motor Vehicle Safety Standard 108 (CMVSS 108) Lighting System and Retroreflective Devices

National Transportation Communications for ITS Protocol (NTCIP):

NTCIP 2101: 2001 SP-PMPP/RS232 Subnetwork Profile

NTCIP 2104: 2003 Ethernet Subnetwork Profile

Others:

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

1X: means single carrier radio transmission technology.

DDNS: means Dynamic Domain Name Service.

Display Module: means a matrix of pixels. A matrix of display modules are used to make up display area of the sign face. A display module is typically 7 rows of pixels by 5 columns of pixels but it can be any size larger than 7x5 that can be managed by maintenance staff when display modules need to be replaced.

GPRS: means General Packet Radio Service.

GPS: means Global Positioning System.

IP: means Internet Protocol.

Pixel: means an assembly of LEDs that collectively form an image-forming unit. All LEDs in a pixel are turned on or off in unison.

PVMS: means a Portable Variable Message Sign that includes display elements, signcase, solar panels, photocell sensor, 1X or GPRS data modem, GPS receiver, electronic compass, batteries, battery enclosure, PVMS controller, controller enclosure, trailer and all other mechanisms and equipment.

Signcase: means all required metal work to enclose the display elements, sheeting, and extended border.

TCP: means Transmission Control Protocol.

UDP: means User Datagram Protocol.

URL: means Universal Resource Locator.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Design Requirements

The design of the signcase and front panels shall comply with the requirements of the current Canadian Highway Bridge Design Code and shall be certified by an Engineer.

4.2 Submission Requirements

4.2.1 The Contractor shall submit shop drawings for the signcase, mounting hardware, solar panel mounting assembly and trailer assembly, product cut-sheets for all off-the-shelf components and calculations proving that the solar panel/battery combination proposed for the Contract meets the Contract requirements.

4.2.2 The Contractor shall provide documentation as evidence of the manufacturer's LED binning process.

4.2.3 Paint colour samples for PVMS and trailer assembly shall be submitted to Owner for approval prior to manufacturing.

5. MATERIALS

5.1 General

5.1.1 The PVMS and all PVMS components shall be fully operational in external ambient temperatures ranging from - 40^{o} C to + 55^{o} C and all forms of precipitation (e.g. rain, snow, freezing rain, etc).

5.1.2 The PVMS and all PVMS components shall be designed for use in 160 km per hour wind gust and 120 km per hour sustained winds.

5.2 Display Elements

5.2.1 The PVMS shall employ high intensity light emitting diode (LED) technology with 4 LEDs per pixel.

5.2.2 Pixels in the ‘on’ position shall be amber, light emitting. Pixels in the ‘off’ position shall be non-light emitting.

5.2.3 PVMS modules shall be of a manageable size for a single person to remove and install without assistance.

5.2.4 All LEDs shall have a nominal wavelength of 590 nm (amber colour) with brightness of 4 candelas (Cd) per LED.

5.2.5 All LEDs shall be of industrial grade and of identical make and model from the same manufacturer.

5.2.6 The LEDs shall be of aluminum indium gallium phosphide technology.

5.2.7 The display matrix shall consist of a full matrix pixel panel.

5.2.8 The minimum number of pixels shall be 30 rows and 56 columns.

5.2.9 The spacing between pixels shall be no less than 63.50 mm and no greater than 69.85 mm as measured from the centre of one pixel to the centre of adjacent pixels both horizontally and vertically. The horizontal and vertical spacing shall be equal.

5.2.10 The luminance of the sign shall be a minimum of 3,500 cd/m^2 at the brightest level and with all the pixels activated within the maximum LED driving characteristics for the maximum design output for all sign operating temperatures.

5.2.11 The minimum luminance ratio under all external sign illuminances (lx) within 400 to 40,000 lx shall be 6 to 1. The luminance ratio (LR) shall be calculated as follows:

LR = (La-Lb) / Lb

La = The measured luminance (cd/m^2) of the element in the ON-state.
Lb = The measured luminance (cd/m^2) of the element in the OFF-state.

5.2.12 The average luminance output from the highest 12% of the pixels to the lowest 12% shall be less than 3:1. The ratio of the average luminance output from the highest 4% of the pixels to the lowest 4% shall be less than 5:1.

5.2.13 The mean time between failure of a single pixel shall not be less than 100,000 hours at the brightest level with ambient air temperature of 35^o C and a relative humidity range of 5% to 100%. Failure of a pixel is defined as the inability to activate more than 25% of the LEDs in a pixel and/or achieving less than 25% of the intended pixel output intensity.

5.2.14 Failure of a pixel or module shall not cause failure of any other pixel or module. Failure of a single LED within a pixel shall cause a loss of intensity of the pixel of less than 25%.

5.2.15 All display elements of the sign shall be of identical material and design to ensure uniformity in characteristics.

5.2.16 When the light sources of the display are operating in a pulse mode, no light flicker shall be visible. The frequency of the light emitted shall be not less than 90 Hz.

5.2.17 The luminance of the sign shall not decrease more than 50% when viewed at a horizontal angle of 7.5^{o} centred about the optical axis and perpendicular to the surface of the display.

5.2.18 Messages displayed on the PVMS shall be legible from fifty (50) metres to three hundred (300) metres.

5.2.19 Messages displayed on the PVMS shall be visible from five hundred (500) metres in all ambient light conditions.

5.3 Signcase

5.3.1 The display elements and associated electronics shall be housed in a weather-tight, NEMA Type 3R housing based on the NEMA 250 specification, designed to provide protection from solar radiation, water, dust, dirt and salt spray.

5.3.2 The housing shall include an alphanumeric identification plate to indicate the Owner's name, a contact telephone number, and a unique identifier. In addition, each sign shall be numbered sequentially and the signcase shall be provided with the two-digit identifier on both edges/sides of the signcase at a size of 100 mm in height or visible from the roadway (i.e. approximately 10 m away). Alternatively, a 300 mm in height two-digit identifier may be placed on the back of the signcase. The Owner shall provide all identification plate information and two-digit identifiers.

5.3.3 The sign face shall be a single, uniform, sheet of non-glare, scratch resistant, high impact, ultraviolet radiation stabilized, polycarbonate sheeting that minimizes glare and reflection of light under all lighting conditions. The polycarbonate sheeting shall be designed to allow easy access to internal sign components for service and repair. The internal sign components, including display elements, shall be secured to prevent shifting during transport and use.

5.3.4 The sign shall have an extended uniform black sign face border outlining the display area surrounded by a continuous 13 mm orange 3M Scotchlite or equivalent retro reflective/fluorescent diamond grade taping at its outer most edge. This border shall extend evenly 100 mm from the outer most pixels on all sides.

5.3.5 A viewfinder shall be integrated on the signcase to accurately align the sign face towards traffic.

5.3.6 The signcase dimensions shall be 4.2 metres (width) by 2.4 metres (height).

5.3.7 The signcase front shall be black and all other surfaces shall be construction orange.

5.4 Solar Panels

5.4.1 The Contractor shall supply appropriate solar panels required to meet the requirements defined elsewhere in this Special Provision.

5.4.2 The solar panels are to be mounted on the top of the signcase on a panel tray.

5.4.3 The solar panel tray shall be capable of tilting and rotating independently from the sign.

5.4.4 All solar panel cable harnesses shall be secured within or to the back of the signcase with appropriate cable length and management to allow for independent solar panel tilting and rotating.

5.4.5 The solar panels shall be secured in a manner to minimize the potential for theft.

5.5 Photocell Sensor

5.5.1 The PVMS shall incorporate a photocell sensor to automatically adjust brightness of LEDs as a function of the ambient light level, within the minimum range of 16 Cd (overbright) to 2 Cd (Night).

5.5.2 The photocell sensor required for automatic LED brightness control shall be mounted on the signcase or on the solar panel tray. All photocell sensor cable harnesses shall be secured within or to the back of the signcase with appropriate cable length and management to allow for applicable movements. The photocell sensor shall be secured in a manner to minimize the potential for theft.

5.6 Mobile Data Communications

5.6.1 The Contractor shall be responsible of establishing and maintaining a third party mobile data service to each PVMS while deployed in the field.

5.6.2 The mobile data service modem shall be capable of supporting a GPRS or alternatively 1X packet-based data communications service.

5.6.3 Each sign shall have a unique URL supported by a DDNS or static IP address to support data communications between all components.

5.6.4 The data communications service shall be capable of a transmission rate of no less than 75kbps.

5.6.5 The mobile data service modem shall interface to the PVMS controller via a hard-wired connection.

5.6.6 The modem shall not require resetting upon power outage or loss of communications.

5.6.7 The Contractor shall be responsible for the supply and installation of an appropriate external 1X or GPRS antenna and modem required for mobile data communications with field deployed PVMS.

5.6.8 The external 1X or GPRS antenna shall be mounted on the top of the signcase or on the solar panel tray. All external antenna cable harnesses shall be secured within or to the back of the signcase with appropriate cable length and management to allow for any required movements of the signcase. The external antenna shall be secured in a manner to minimize the potential for theft.

5.7 GPS Receiver

5.7.1 The GPS receiver shall be mounted within the signcase or on the solar panel tray. All GPS receiver cable harnesses shall be secured within or to the back of the signcase with appropriate cable length and management to allow for applicable movements. The GPS receiver shall be secured in a manner to minimize the potential for theft.

5.7.2 The GPS receiver shall have latitude and longitude accuracy of three metres (3 m) or better.

5.7.3 The GPS receiver shall have latitude and longitude resolution of one half metre (0.5 m) or better.

5.7.4 The GPS receiver shall have a maximum start acquisition time of 60 seconds.

5.7.5 The GPS receiver shall have a user configurable navigation update time, with a minimum rate of 5 seconds.

5.7.6 The GPS receiver shall have an acquisition sensitivity of -130 dBm or better.

5.7.7 The GPS receiver shall have a digital interface.

5.8 Electronic Compass

5.8.1 The electronic compass shall be mounted either within or on the back of the signcase. All electronic compass cable harnesses shall be secured either within or on the back of the signcase with appropriate cable length and management to allow for applicable movements. If the electronic compass is mounted on the back of the signcase, it shall be secured in a manner to minimize the potential for theft.

5.8.2 The electronic compass shall provide three hundred and sixty degrees (360^o) direction readings, where zero degrees (0^o) represents North.

5.8.3 Readings shall reference which direction the front of the signface is facing.

5.8.4 The electronic compass shall have a heading resolution of one half a degree (0.5^o) or better.

5.8.5 The electronic compass shall have a heading accuracy of one degree (1^o) or better.

5.8.6 The electronic compass shall have a maximum start acquisition time of 60 seconds.

5.8.7 The electronic compass shall have a user configurable reading update time, with a minimum rate of 5 seconds.

5.8.8 The electronic compass shall have a digital interface.

5.9 Trailer

5.9.1 Trailer Mechanisms

5.9.1.1 The trailer shall meet all Highway Traffic Act Regulations. The trailer shall be of all steel construction with a single axle, two wheels and a deck of sufficient size to mount the sign.

5.9.1.2 PVMS trailer assemblies shall require high reflectivity microprismatic tape meeting the requirements of CMVSS 108. The reflectorized tape shall be of alternating red and white sections, and shall be 50mm in width applied to rear and side faces of the trailer.

5.9.1.3 The trailer shall be equipped with walk-on heavy-duty flat-topped fenders. Non-slip treads shall be provided at all locations where service/maintenance climbing and standing will be required.

5.9.1.4 Four jacks shall be provided to stabilize the trailer. Jacks shall be provided which will level the trailer on a 1-in-6 gradient and prevent trailer movement or instability under the required display position wind loading described elsewhere in this Special Provision. A bull's eye level or equivalent levelling tool shall be attached to the trailer to assist in the levelling operation.

5.9.1.5 Other than wheel contact, the trailer shall not strike the road at railway crossings or in the mounting or descending of 200 mm (8-inch) high curbs.

5.9.1.6 Suspension shall be compatible with the total weight of the trailer with all components installed, including display elements, signcase, solar panels and batteries.

5.9.1.7 Wheels shall be an automotive type properly rated for the required load.

5.9.1.8 A sufficient capacity hydraulic surge brake system shall be provided.

5.9.2 Dimensions

5.9.2.1 The trailer shall be capable of supporting the signcase in display mode at maximum height of 2.5m from ground level to the bottom of the signcase.

5.9.2.2 Maximum overall trailer length from tongue to rear bumper shall be 5.5 metres.

5.9.2.3 Maximum gross trailer weight with all components installed, including, display elements, signcase, solar panels and batteries shall be 2,500 kilograms.

5.9.3 Transportation

5.9.3.1 The trailer hitch shall be a removable, heavy duty forged steel pintle eye type, with an adjustable height from 635 mm to 864 mm above ground. The hitch pintle eye "I.D." shall be 76 mm, and shall be rated with sufficient capacity for the total weight of the trailer with all components installed, including display elements, signcase, solar panels and batteries.

5.9.3.2 Safety chains shall be suitably anchored to the main frame of the trailer, or the tongue if the tongue is an extension of the main frame.

5.9.3.3 The safety chains shall be positioned and long enough so that they cross under the tongue in order to prevent the tow bar from dropping to the ground in the event of a disconnect of the coupling device.

5.9.3.4 Safety eye hooks or round pin anchor shackles shall be supplied.

5.9.3.5 All trailer couplings and safety connecting devices must conform to the Ontario Regulation 618.

5.9.4 Security

5.9.4.1 Weather resistant, wheel locks and other measures shall be provided to maintain the security of the PVMS's on site.

5.9.4.2 Three (3) sets of master keys, keyed alike, shall be provided for all locked components and enclosures, including the signcase, battery enclosure, and controller enclosure.

5.9.4.3 Lock design shall prevent ingress of water and ice.

5.9.5 Trailer Tow Lighting System

5.9.5.1 A 12 Volt DC trailer tow lighting system shall be provided for the PVMS trailer and shall include taillights, stoplights and clearance markers.

5.9.5.2 Heavy-duty marine type salt-resisting wiring and standard circular male 6-pin tow vehicle connector shall be supplied with appropriate length to connect to the tow vehicle.

5.9.5.3 All lamps and wiring shall conform to the Highway Traffic Act Regulations.

5.9.6 Paint

5.9.6.1 The trailer assemblies shall be painted uniform finish. The PVMS trailer paint shall match the signcase.

5.9.7 Lifting and Locking Mechanism

5.9.7.1 The PVMS shall be fitted with a lifting mechanism that can be powered by the internal batteries. The mechanism shall be designed and installed with sufficient capacity to safely and quickly raise and lower both the signcase and solar panel array.

5.9.7.2 The lifting mechanism shall incorporate independent locking devices to secure both the signcase and solar panel array in display and transport positions.

5.9.7.3 In display position, the locking mechanism shall be designed to prevent lowering of the signcase and solar panel array upon loss of power or any wind conditions.

5.9.7.4 In transport position, the locking mechanism shall be designed to prevent raising, rotation and damage to both the signcase and solar panel when subjected to normal shock, vibrations and winds experienced during PVMS transportation.

5.10 PVMS Mounting and Structural Design Requirements

5.10.1 The PVMS assembly shall be constructed of structural steel members to ensure a structurally sound, operational and transportable platform.

5.10.2 The structural design shall incorporate a universal sign mounting assembly that readily facilitates mounting of the signcase to either fixed pole or overhead truss locations.

5.10.3 Any sign and trailer components including the hitch, fastening and safety devices that are exposed to the external environment shall be made of corrosion resistant material. The design of the fastening and safety device shall allow removal and/or replacement of the signcase.

5.11 Electrical System

5.11.1 The PVMS shall be designed to operate continuously on solar power and deep cycle batteries such that there is no requirement for external charging between April 1 and November 30 within Ontario.

5.11.2 A charging control device shall be utilized to protect the solar array from overcharging the batteries. The fully charged deep cycle battery pack shall be capable of powering the PVMS for seven (7) consecutive days, 24 hours a day, at a display utilization of 20% of pixels as required in the table below.

Two-Phase Message	Operating Conditions	Minimum Duration of Continuous Operation Required Without Charging
CCCCCCCC CCCCCCCC CCCCCCCC and FFFFFFFF FFFFFFFF FFFFFFFF	-10 degrees Celsius through to +55 degrees Celsius (April 1 to November 30)	seven (7) consecutive days

5.11.3 The PVMS design shall accommodate external charging via a generator or continuous hardwired power feed. The external charging shall include power conversion equipment required to convert an input voltage of 115 VAC ± 15%, 60 Hz ± 5% to the required DC voltage and current plus facilities to protect the batteries from overcharging.

5.11.4 The PVMS design shall accommodate a continuous, hardwired AC power feed with both the solar panels and batteries removed. The VMS shall include power conversion equipment required to convert an input voltage of 115 VAC ± 15%, 60 Hz ± 5% to the required DC voltage and current to maintain all VMS sign functions and components, including raising and lowering the signcase.

5.11.5 All electrical/electronic components shall be of modular, interchangeable, plug-in type fabrication and shall be standard manufacturers' components and CSA certified, where possible. If no CSA standards are available for a proposed component, other standards organization certification may be substituted with the approval of the Contract Administrator. All electrical/electronic components shall either be located inside locked compartments or if exposed, shall be secured in a manner to minimize the potential for unauthorized disconnection.

5.11.6 All exposed cables and cable harnesses shall be heavy-duty marine type salt-resisting. All exposed and internal connectors shall be keyed to prevent accidental incorrect connections and incorporate a mechanical locking mechanism. All exposed connectors shall be water tight to reduce pin/socket corrosion.

5.12 Local PVMS Control

5.12.1 The PVMS shall provide a high contrast, field hardened, weather-proofed display screen and keyboard suitably installed within the controller cabinet to sustain normal shock and vibration experienced during PVMS transportation.

5.12.2 Local PVMS control shall be available when the PVMS is energized by either battery power or continuous hardwired AC power.

5.12.3 The local PVMS control user interface shall be easy to use and menu driven. The use of complex commands or syntax shall not be permitted.

5.12.4 Local PVMS control shall provide a minimum two level password protection to selected menus and options. Level one users shall have access to "diagnostics", and "sign control functions". Level two users shall have access to “sign configurations”, “communications configurations”, “user management”, and a “message editor”.

5.12.5 As a minimum, the level one user “diagnostics” shall provide current date and time, current battery charging and draining voltages, display element module failures, GPS latitude and longitude details, signface attitude, current displayed message content, message Owner and source.

5.12.6 As a minimum, the level one user “sign control functions” shall provide the ability to view and display a message or message sequence, and create, view and edit message schedules.

5.12.7 As a minimum, the level two user “message editor” shall provide the ability to create, view and edit any changeable and volatile messages and message sequences. Messages and message sequences may consist of up to 2 pages, where each page contains up to 3 lines, and each line contains up to 12 characters. The message editor shall include selecting desired sign protocol font, page and line justifications and page display times for individual message lines and pages. The message editor shall be easy to use and shall not require the user to enter or have any prior knowledge of the sign’s protocol tags. The interface shall permit knowledgeable users to include any supported protocol tags within any message text.

5.12.8 As a minimum, the level two user “sign configurations” shall provide the ability to create, view and edit the local date and time, all required non-volatile settings including communications and power loss messages and default settings, including sign protocol font, page and line justifications, and page times.

5.12.9 As a minimum, the level two user “communications configurations” shall provide the ability to view and edit all required PVMS network settings. The PVMS network setting shall include the unique URL supported by a DDNS or static IP address, network mask, gateway settings, and the sign’s protocol default administrator community string and Internet Transport Profile.

5.12.10 As a minimum, the level two user “user management” shall provide the ability to create, view and edit up to four (4) user names, passwords and assigning access level one or two to each individual user.

5.13 PVMS Controller

5.13.1 General

The PVMS controller shall be IP addressable and provide an externally accessible and suitable labelled twisted pair Ethernet (10baseT or 100baseT) female DTE RJ-45 port required for NTCIP 2104. The PVMS controller shall provide an externally accessible male DTE DB-9 serial port as required for NTCIP 2101. The PVMS controller shall provide other externally accessible ports (Ethernet or serial) as required for local PVMS control and communications to various PVMS components. The PVMS controller shall concurrently accept commands from both the externally accessible Ethernet and serial port and local PVMS control.

5.13.2 Global Positioning Systems Integration

5.13.2.1 The PVMS controller shall interface directly to the GPS receiver via a hard-wired connection.

5.13.2.2 The PVMS controller shall extract the latitude and longitude location data from the GPS receiver once per minute, then update the required latitude and longitude object values.

5.13.3 Electronic Compass Integration

5.13.3.1 The PVMS controller shall interface directly to the electronic compass via a hard-wired connection.

5.13.3.2 The PVMS controller shall extract the required sign display facing data from the electronic compass at least once per minute, then update the required bearing object value.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 All electrical installations shall meet the requirements of Ontario Electrical Safety Code.

7.2 Minimum distance from the bottom of the signcase to ground level when in display mode shall be 1.5 metres.

7.3 Delivery

PVMS signs shall be delivered to a location designated by the Contract Administrator.

7.4 Quality Control

7.4.1 Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

7.4.2 The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.2.1	√		
5.2.2	√ [3,4,5]	√	
5.2.3	√		
5.2.4	√		
5.2.7	√		
5.2.8	√		
5.2.9	√		
5.2.10	√ [1]		
5.2.11	√		
5.2.12	√ [2]		
5.2.14	√		
5.2.17	√		

CLAUSE	PIT	POP	SIT
5.2.18	√	√ [7]	
5.2.19		√ [7]	
5.3.1	√		
5.3.2	√		
5.3.3	√		
5.3.4	√		
5.3.5	√		
5.3.6	√		
5.5.1	√		
5.6.1			√
5.6.4	√	√	
5.6.6		√	√
5.7.4	√		
5.7.5	√		
5.8.6	√		
5.8.7	√		
5.9.2.2	√		
5.9.5.1	√		
5.9.7.1	√		
5.9.7.2	√		
5.9.7.3	√		
5.9.7.4	√		
5.11.2	√		
5.12.2	√		
5.12.3	√		
5.12.4	√		
5.12.5	√		
5.12.6	√		
5.12.7	√		
5.12.8	√		
5.12.9	√		
5.12.10	√		

CLAUSE	PIT	POP	SIT
5.13.1	√	√	√ [6]
5.13.2.2	√	√	√
5.13.3.2	√	√	√
7.2	√		

<u>Testing Footnotes:</u>

[1] The LED pixels shall be tested to ensure suitability for the application. As a minimum, the LED pixels shall pass the following test:

a) A random sample of not less than 50 pixels shall be activated continuously at the brightest design output level at the predicted maximum temperature adjacent to LED pixels inside the signcase. The duration of the test shall be sufficient to verify satisfactory operation of all pixels to simulate a total pixel operation of not less than 150,000 hours. The test shall be considered as failed upon any single failure of the pixel in the test sample.

b) Prior to the manufacturing of the sign, the Contractor shall provide proof of certified testing by the manufacturer or conduct the above test to the satisfaction of the Contract Administrator. The Contractor is responsible for any re-test or design modification of the pixel to satisfy the above test criteria.

[2] Subjective assessment of colour uniformity.

[3] Demonstration of all pixels activated/deactivated in alternating mode using a checkerboard test pattern for 30 minutes minimum.

[4] Demonstration of operation with the VMS Controller Unit including demonstration of the use of all software commands which are capable of operating the pixels.

[5] Continuous operation over 72 hours using a message display change every 15 minutes. Any pixel failures during this test will require satisfactory repeat of the complete test. Demonstration of various pixel luminance levels, set and operating in accordance with the specifications, is required. The signcase shall not be covered during this operation.

[6] The Contractor shall carry out system integration testing to ensure that the PVMS and PVMS Controller perform to the specified standards when used in operation with all other devices.

[7] Visibility tests including test drives during day and night conditions to verify the legibility distance. Testing at dawn or sunset will be required depending on site location. Pixel luminance shall vary automatically during the tests.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of portable variable message signs, trailer mounted, is by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above item shall be full compensation for all labour, Equipment and Materials required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except for SIT which is paid for under a separate item.

NOTES TO DESIGNER:

* The Designer shall approve the need for the PVMS and their quantity with the MTO Traffic Office

WARRANTS: Always with this item.

FIXED SUPPORT MOUNTABLE VARIABLE MESSAGE SIGNS - Item No.

Special Provision No. 685S07 September 2007

1. SCOPE

This Special Provision covers the requirements for the delivery, installation, documentation and testing of Variable Message Signs (VMS) to be mounted on a support structure. The structure and the structure foundations shall be supplied under separate items.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Canadian Standards Association:

CAN/CSA-S6-00 Canadian Highway Bridge Design Code

National Electrical Manufacturers Association (NEMA):

NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum)-NEMA 3R

Highway Traffic Act R.R.O. 1990:

Ontario Regulation 618 Specifications and Standards for Trailer Couplings

National Transportation Communications for ITS Protocol (NTCIP):

NTCIP 2101: 2001 SP-PMPP/RS232 Subnetwork Profile

NTCIP 2104: 2003 Ethernet Subnetwork Profile

Others:

Ontario Electrical Safety Code

3. DEFINITIONS

For the purpose of this Special Provision, the following definitions apply:

1X: means single carrier radio transmission technology.

DDNS: means Dynamic Domain Name Service.

Display Module: means a matrix of pixels. A matrix of display modules are used to make up display area of the sign face. A display module is typically 7 rows of pixels by 5 columns of pixels but it can be any size larger than 7x5 that can be managed by maintenance staff when display modules need to be replaced.

IP: means Internet Protocol.

Pixel: means an assembly of LEDs that collectively form an image-forming unit. All LEDs in a pixel are turned on or off in unison.

VMS: means a Variable Message Sign that includes display elements, signcase, VMS controller, controller enclosure and all other mechanisms and equipment required to enable placement of the VMS on the support structure.

Signcase: means all required metal work to enclose the display elements, sheeting, and extended border.

TCP: means Transmission Control Protocol.

UDP: means User Datagram Protocol.

URL: means Universal Resource Locator.

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Design Requirements

The design of the signcase and front panels shall comply with the requirements of the current Canadian Highway Bridge Design Code and shall be certified by an Engineer.

4.2 Submission Requirements

4.2.1 The Contractor shall submit shop drawings for the signcase, mounting hardware, cabinet and product cut-sheets for all off-the-shelf components.

4.2.2 The Contractor shall provide documentation as evidence of the manufacturer's LED binning process.

4.2.3 Paint colour samples shall be submitted to Owner for approval prior to manufacturing.

5. MATERIALS

5.1 General

5.1.1 The VMS and all VMS components shall be fully operational in external ambient temperatures ranging from - 40^{o}C to + 55^{o}C and all forms of precipitation (e.g. rain, snow, freezing rain, etc).

5.1.2 The VMS and all VMS components shall be designed for use in 160 km per hour wind gusts and 120 km per hour sustained winds.

5.2 Display Elements

5.2.1 The VMS shall employ high intensity light emitting diode (LED) technology with 4 LEDs per pixel.

5.2.2 Pixels in the 'on' position shall be amber, light emitting. Pixels in the 'off' position shall be non-light emitting.

5.2.3 VMS modules shall be of a manageable size for a single person to remove and install without assistance. Modules shall be no smaller than 9 pixel rows by 7 pixel columns.

5.2.4 All LEDs shall have a nominal wavelength of 590 nm (amber colour) with brightness of 4 candelas (Cd) per LED.

5.2.5 All LEDs shall be of industrial grade and of identical make and model from the same manufacturer.

5.2.6 The LEDs shall be of aluminium indium gallium phosphide technology.

5.2.7 The display matrix shall consist of a full matrix pixel panel.

5.2.8 The minimum number of pixels shall be 30 rows and 56 columns.

5.2.9 The spacing between pixels shall be no less than 63.50 mm and no greater than 69.85 mm as measured from the centre of one pixel to the centre of adjacent pixels both horizontally and vertically. The horizontal and vertical spacing shall be equal.

5.2.10 The luminance of the sign shall be a minimum of 3,500 cd/m^2 at the brightest level and with all the pixels activated within the maximum LED driving characteristics for the maximum design output for all sign operating temperatures.

5.2.11 The minimum luminance ratio under all external sign illuminances (lx) within 400 to 40,000 lx shall be 6 to 1. The luminance ratio (LR) shall be calculated as follows:

$LR = (La-Lb) / Lb$

La = The measured luminance (cd/m^2) of the element in the ON-state.
Lb = The measured luminance (cd/m^2) of the element in the OFF-state.

5.2.12 The average luminance output from the highest 12% of the pixels to the lowest 12% shall be less than 3:1. The ratio of the average luminance output from the highest 4% of the pixels to the lowest 4% shall be less than 5:1.

5.2.13 The mean time between failure of a single pixel shall not be less than 100,000 hours at the brightest level with ambient air temperature of 35^o C and a relative humidity range of 5% to 100%. Failure of a pixel is defined as the inability to activate more than 25% of the LEDs in a pixel and/or achieving less than 25% of the intended pixel output intensity.

5.2.14 Failure of a pixel or module shall not cause failure of any other pixel or module. Failure of a single LED within a pixel shall cause a loss of intensity of the pixel of less than 25%.

5.2.15 All display elements of the sign shall be of identical material and design to ensure uniformity in characteristics.

5.2.16 When the light sources of the display are operating in a pulse mode, no light flicker shall be visible. The frequency of the light emitted shall be not less than 90 Hz.

5.2.17 The luminance of the sign shall not decrease more than 50% when viewed at a horizontal angle of 7.5^o centred about the optical axis and perpendicular to the surface of the display.

5.2.18 Messages displayed on the VMS shall be legible from fifty (50) metres to three hundred (300) metres.

5.2.19 Messages displayed on the VMS shall be visible from five hundred (500) metres, in all ambient light conditions.

5.3 Signcase

5.3.1 The display elements and associated electronics shall be housed in a weather-tight, NEMA Type 3R housing based on the NEMA 250 specification, designed to provide protection from solar radiation, water, dust, dirt and salt spray.

5.3.2 The sign face shall be a single, uniform, sheet of non-glare, scratch resistant, high impact, ultraviolet radiation stabilized, polycarbonate sheeting that minimizes glare and reflection of light under all lighting conditions. The polycarbonate sheeting shall be designed to allow easy access to internal sign components for service and repair. The internal sign components, including display elements, shall be secured to prevent shifting during transport and use.

5.3.3 The sign shall have an extended uniform black sign face border outlining the display area surrounded by a continuous 13 mm orange 3M Scotchlite or equivalent retro reflective/fluorescent diamond grade taping at its outer most edge. This border shall extend evenly 100mm from the outer most pixels on all sides.

5.3.4 A viewfinder shall be integrated on the signcase to accurately align the sign face towards traffic.

5.3.5 The signcase dimensions shall be 4.2 metres (width) by 2.4 metres (height).

5.3.6 The signcase front shall be black and all other surfaces shall be construction orange.

5.4 VMS Mounting and Structural Design Requirements

5.4.1 The VMS assembly shall be constructed of structural steel members to ensure a structurally sound, operational and transportable unit.

5.4.2 The structural design shall incorporate a universal sign mounting assembly that readily facilitates mounting of the signcase to either single support structure or overhead truss locations.

5.5 Photocell Sensor

5.5.1 The VMS shall incorporate a photocell sensor to automatically adjust brightness of LEDs as a function of the ambient light level, within the minimum range of 16 Cd (overbright) to 2 Cd (Night).

5.5.2 The photocell sensor required for automatic LED brightness control shall be mounted on the signcase or on the solar panel tray. All photocell sensor cable harnesses shall be secured within or to the back of the signcase with appropriate cable length and management to allow for applicable movements. The photocell sensor shall be secured in a manner to minimize the potential for theft.

5.6 VMS Cabinet

5.6.1 The sign shall be supplied with a waterproof cabinet of sufficient size and design to house the VMS controller hardware, modem, uninterruptible power supply unit and power and telephone circuit terminals.

5.6.2 The cabinet shall be made of aluminium, minimum 0.3 mm thick, painted the same color as VMS and suitable for mounting on the VMS support structure in a roadway environment.

5.6.3 The cabinet design shall include any heating and ventilation features to create an adequate environment for the control and communications hardware for year round operation in the environmental conditions present in at the sign location. The design shall incorporate drainage facilities to drain condensation to the outside.

5.7 Electrical System

5.7.1 The VMS and VMS cabinet design shall accommodate a continuous, hardwired AC power feed. The VMS shall include power conversion equipment required to convert an input voltage of 115 VAC ± 15%, 60 Hz ± 5% to the required DC voltage and current to maintain all VMS sign functions and components.

5.7.2 All electrical/electronic components shall be of modular, interchangeable, plug-in type fabrication and shall be standard manufacturer's components and CSA certified, where possible. If no CSA standards are available for a proposed component, other standards organization certification may be substituted with the approval of the Contract Administrator. All electrical/electronic components shall be secured in a manner to minimize the potential for unauthorized disconnection.

5.7.3 All exposed cables and cable harnesses shall be heavy-duty marine type salt-resisting. All exposed and internal connectors shall be keyed to prevent accidental incorrect connections and incorporate a mechanical locking mechanism. All exposed connectors shall be water tight to reduce pin/socket corrosion.

5.8 Local VMS Control

5.8.1 The VMS shall provide a high contrast, field hardened, weather proofed display screen and keyboard suitably installed within the controller cabinet to sustain normal shock and vibration experienced during VMS transportation.

5.8.2 Local VMS control shall be available when the VMS is energized by continuous hardwired AC power.

5.8.3 The local VMS control user interface shall be easy to use and menu driven. The use of complex commands or syntax shall not be permitted.

5.8.4 Local VMS control shall provide a minimum two level password protection to selected menus and options. Level one users shall have access to "diagnostics", and "sign control functions". Level two users shall have access to "sign configurations", "communications configurations", "user management", and a "message editor".

5.8.5 As a minimum, the level one user "diagnostics" shall provide current date and time, current displayed message content, message Owner and source.

5.8.6 As a minimum, the level one user "sign control functions" shall provide the ability to view and display a message or message sequence, and create, view and edit message schedules.

5.8.7 As a minimum, the level two user "message editor" shall provide the ability to create, view and edit any changeable and volatile messages and message sequences. Messages and message sequences may consist of up to 2 pages, where each page contains up to 3 lines, and each line contains up to 12 characters. The message editor shall include selecting the desired sign protocol font, page and line justifications and page display times for individual message lines and pages. The message editor shall be easy to use and shall not require the user to enter or have any prior knowledge of the sign's protocol tags. The interface shall permit knowledgeable users to include any supported protocol tags within any message text.

5.8.8 As a minimum, the level two user "sign configurations" shall provide the ability to create, view and edit the local date and time, all required non-volatile settings including communications and power loss messages and default settings, including sign protocol font, page and line justifications, and page times.

5.8.9 As a minimum, the level two user "communications configurations" shall provide the ability to view and edit all required VMS network settings. The VMS network settings shall include the unique URL supported by a DDNS or static IP address, network mask, gateway settings, and the sign's protocol default administrator community string and Internet Transport Profile.

5.8.10 As a minimum, the level two user "user management" shall provide the ability to create, view and edit up to four (4) user names, passwords and assigning access level one or two to each individual user.

5.9 VMS Controller

The VMS controller shall be IP addressable and provide an externally accessible and suitable labelled twisted pair Ethernet (10baseT or 100baseT) female DTE RJ-45 port required for NTCIP 2104. The VMS controller shall provide an externally accessible male DTE DB-9 serial port as required for NTCIP 2101. The VMS controller shall provide other externally accessible ports (Ethernet or serial) as required for local VMS control and communications to various VMS components. The VMS controller shall concurrently accept commands from both the externally accessible Ethernet and serial port and local VMS control.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

All electrical installations shall meet the requirements of Ontario Electrical Safety Code.

7.1 Installation

7.1.1 The display and cabinet for the VMS shall be mounted to a sign support as shown in the drawings.

7.1.2 Power and control cables shall be installed within and/or attached to the sign support structure. All exposed cables shall be installed in watertight conduits.

7.1.3 The VMS and the VMS cabinet shall be energized immediately following installation.

7.1.4 The Contractor shall install a laminated phenolic plastic nameplate on each installed VMS cabinet depicting VMS universal identifier. The nameplate shall be installed on the side of the cabinet facing the highway or so as to be easily seen when approaching along the highway. The nameplates shall be 450 mm x 70 mm with 50 mm high with white lettering, 8 mm letter stroke width and 6 mm spacing between letters, on a black background (Example: 401VE0420VEC). Letters shall be generated by an engraving machine. The nameplates shall be fastened with four stainless steel self tapping screws, with 'Robertson' No. 2 (red) heads. The Contractor shall confirm the nameplate information with the Contract Administrator prior to manufacturing the nameplates. The nameplate shall contain the full 12 characters of the universal identifier including the highway name.

7.2 Quality Control

The Contractor is responsible for all testing and documentation required to establish approval and acceptance of installation and operation of this equipment. The framework of the approval process shall be as specified elsewhere in the Contract Documents.

The following table details the clauses within this Special Provision, which are to be validated through the PIT, POP, and SIT processes as indicated:

CLAUSE	PIT	POP	SIT
5.2.1	√		
5.2.2	√ [3,4,5]	√	
5.2.3	√		
5.2.4	√		
5.2.7	√		
5.2.8	√		
5.2.9	√		
5.2.10	√ [1]		
5.2.11	√		
5.2.12	√ [2]		
5.2.14	√		
5.2.17	√		
5.2.18	√	√ [7]	
5.2.19		√ [7]	
5.3.1	√		
5.3.2	√		
5.3.3	√		
5.3.4	√		
5.3.5	√		
5.3.6	√		
5.5.1	√	√	
5.8.1	√	√	
5.8.2	√		
5.8.3	√		

CLAUSE	PIT	POP	SIT
5.8.4	√		
5.8.5	√		
5.8.6	√		
5.8.7	√		
5.8.8	√		
5.8.9	√		
5.8.10	√		
5.9	√	√	√ [6]

Testing Footnotes:

[1] The LED pixels shall be tested to ensure suitability for the application. As a minimum, the LED pixels shall pass the following test:

a) A random sample of not less than 200 pixels shall be activated continuously at the brightest design output level at the predicted maximum temperature adjacent to LED pixels inside the signcase. The duration of the test shall be sufficient to verify satisfactory operation of all pixels to simulate a total pixel operation of not less than 150,000 hours. The test shall be considered as failed upon any single failure of the pixel in the test sample.

b) Prior to the manufacturing of the sign, the Contractor shall provide proof of certified testing by the manufacturer or conduct the above test to the satisfaction of the Contract Administrator. The Contractor is responsible for any re-test or design modification of the pixel to satisfy the above test criteria.

[2] Subjective assessment of colour uniformity.

[3] Demonstration of all pixels activated/deactivated in alternating mode using a checkerboard test pattern for 30 minutes minimum.

[4] Demonstration of operation with the VMS Controller Unit including demonstration of the use of all software commands which are capable of operating the pixels.

[5] Continuous operation over 72 hours using a message display change every 15 minutes. Any pixel failures during this test will require satisfactory repeat of the complete test. Demonstration of various pixel luminance levels, set and operating in accordance with the specifications, is required. The signcase shall not be covered during this operation.

[6] The Contractor shall carry out system integration testing to ensure that the VMS and VMS Controller perform to the specified standards when used in operation with all other devices.

[7] Visibility tests including test drives during day and night conditions to verify the legibility distance. Testing at dawn or sunset will be required depending on site location. Pixel luminance shall vary automatically during the tests.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of fixed support mountable variable message signs is by Plan Quantity, as may be revised by Adjusted Plan Quantity.

The unit of measurement is each.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work including delivery, installation, testing and the production of all drawings, text and test results, except for SIT which is paid for under a separate item.

WARRANT: Always with this item.

<u>RACK ASSEMBLIES</u> - Item No.

Special Provision No. 687S01 September 2007

1. SCOPE

This Special Provision covers the requirements for the installation of rack assemblies including power distribution equipment.

2. REFERENCES

This Special Provision refers to the following standards, specifications or publications:

Electronic Industries Alliance / Telecommunications Industry Association:

EIA-310-D Cabinets, Racks, Panels and Associated Equipment

Others:

Ontario Electrical Safety Code

3. DEFINITIONS – Not Used

4. DESIGN AND SUBMISSION REQUIREMENTS

4.1 Submission Requirements

The Contractor shall submit product specification sheets to the Contract Administrator for review prior to ordering.

5. MATERIALS

5.1 Rack Assemblies

5.1.1 The rack assemblies shall be heavy duty welded with 14 gauge steel fame, 16 gauge side panels.

5.1.2 The rack assemblies shall accommodate standard EIA 480 mm rack mountable equipment.

5.1.3 The height of the rack assemblies shall be a minimum 1960 mm and a maximum 2130 mm.

5.1.4 The minimum width of the rack assemblies shall be 580 mm.

5.1.5 The minimum depth of the rack assemblies shall be 600 mm.

5.1.6 The rack assemblies shall have a minimum rated loading of 680 kg.

5.1.7 The rack assemblies shall be painted grey with a rugged textured power paint finish.

5.1.8 The rack assemblies shall be complete with tops and lockable louvered smoked plexiglass doors on the front and back.

5.1.9 The doors shall be of 16 gauge steel with smoked plexiglass insert.

5.1.10 Both doors shall allow full access to space between panel rails when open.

5.1.11 Both doors shall be the same width and height as the rack assemblies.

5.1.12 The rack assembly rails shall be made of 10 gauge zinc plated steel.

5.1.13 Each cabinet shall be supplied with a 120 VAC 60 Hz power distribution assembly for the equipment in the cabinets. The power distribution assembly shall be an eight-receptacle power bar with a circuit breaker and switch or a circuit breaker, which can also act as a switch. The power distribution assembly shall be rack mountable and shall plug into a type 5-15R receptacle.

5.2 Low Voltage Cables

Low voltage cables shall be armoured with 2 - #12 AWG copper type RW- 90 XLPE and 1 - #12 AWG bare copper ground rated for 600 volts.

5.3 Receptacles

Receptacles shall be twist lock type rated for 120 V, CSA approved 5-15R. The receptacles shall be suitable for installation under a raised floor.

5.4 Circuit Breakers

Circuit breakers shall be CSA approved, 15 Amp, 120 V single pole, SWD suitable for mounting in an existing wire panel board or a panel board supplied under this Contract, whichever applies.

6. EQUIPMENT – Not Used

7. CONSTRUCTION

7.1 The Contractor shall install the rack assemblies as indicated in the drawing package.

7.2 Prior to installation, the Contractor shall confirm with the Contract Adminitrator the location of the rack assemblies and the proposed arrangement of the equipment to be mounted in the rack assemblies shown in the Contract Drawings.

7.3 The power distribution assembly shall be mounted in the rear portion of the rack at the bottom. The power receptacles shall be facing outwards.

7.4 The ground lug of the existing rack assembly shall be secured to the grounding grid in the communications room by a #6 AWG ground wire.

7.5 The rack power distribution assembly shall be connected to a duplex twist lock receptacle mounted under the rack assembly.

7.6 Each rack assembly in the communications room shall be individually supplied by a separate circuit from the panel board. For facilities with an existing panel board, the Contractor shall inspect the panel board to ensure that supplied breakers match the panel type. The Contractor shall install low voltage cables from the receptacle mounted under each rack assembly to the panel board by routing the cable in the existing cable raceway or as shown in the Contract Drawings. Each cable shall be identified by its appropriate circuit designation.

7.7 The installation of the power distribution equipment shall be carried out in accordance with the Ontario Electrical Safety Code. The Contractor shall label the appropriate information on the panel board door which identifies the circuit to rack assembly relationship.

8. QUALITY ASSURANCE – Not Used

9. MEASUREMENT FOR PAYMENT

Measurement of the number of rack assemblies is by Plan Quantity as may be revised by Adjusted Plan Quantity.

10. BASIS OF PAYMENT

Payment at the Contract price for the above tender item shall be full compensation for all labour, Equipment and Materials required to do the work.

WARRANT: Always with this item.