



COMMONWEALTH of VIRGINIA

DEPARTMENT OF TRANSPORTATION
1401 EAST BROAD STREET
RICHMOND, VIRGINIA 23219-2000

Stephen C. Brich, P.E.
Commissioner

April 10, 2020

Order No.: C53
Project: 0003-036-610, C501
FHWA: STP-5A03(932), STP-5A03(933)
District: Fredericksburg
County: Gloucester
Route: 3
Bids: 10:00 a.m. Wednesday April 22, 2020

To Holders of Bid Proposals:

Please make the following changes in your copy of the bid proposal and plans for the captioned project:

BID PROPOSAL

Substitute the Schedule of Items as they have been revised.

Substitute the Determination of Major Items as it has been revised.

Substitute the Bid Items Eligible for Fuel Adjustment as it has been revised.

Substitute the Bid Items Eligible for Steel Price Adjustment as it has been revised.

Substitute the Table of Contents as it has been revised.

Substitute page 149 the Supplemental Spec for Section 703—Traffic Signals has been removed.

Substitute pages 151 through 154 the SP for Cellular Router has been removed.

Add pages 155 through 171 the SP for Advanced Transportation Controller (ATC) Cabinet - 5-Door Configuration has been added.

Add page 172 the Supplemental Spec for Section 703—Traffic Signals has been added.

Add pages 173 through 176 the SP for Accessible Pedestrian Signal Equipment has been added.

Add pages 177 through 180 the revised SP for Cellular Router has been added.

PLANS

Substitute the following plan sheet as they have been revised.

0003-036-610 501_01 R5
0003-036-610 501_01a R5
0003-036-610 501_01c R5
0003-036-610 501_01e R5
0003-036-610 501_01f R5
0003-036-610 501_01g(01) R5
0003-036-610 501_01g(02) R5
0003-036-610 501_01g(02a) R5
0003-036-610 501_01g(03) R5
0003-036-610 501_01g(03a) R5
0003-036-610 501_01g(04) R5
0003-036-610 501_02a R5
0003-036-610 501_02C(2) R5
0003-036-610 501_03 R5
0003-036-610 501_03a R5
0003-036-610 501_03b R5
0003-036-610 501_03c R5
0003-036-610 501_03d R5
0003-036-610 501_03E R5
0003-036-610 501_07(02) R5

Substitute the following Cross section as they have been revised.

0003-036-610 501_X1 R5
0003-036-610 501_x2 R5
0003-036-610 501_x3 R5
0003-036-610 501_x4 R5
0003-036-610 501_x5 R5
0003-036-610 501_x6 R5
0003-036-610 501_x7 R5
0003-036-610 501_x8 R5
0003-036-610 501_x9 R5

These plans are available to be viewed and downloaded from the ProjectWise.

Harold R. Caples, P. E.
State Contract Engineer
Construction Division

Enclosures

Proposal ID: C0000109471C01 Oversight/State Project No.: 0003-036-610, C501
 Order No.: C53 Federal Project No.: STP-5A03(932)

Contractor: _____

SECTION: 0001 REGULAR BID ITEMS

Cat Alt Set ID: Cat Alt Mbr ID:

Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
0010	513	00100 MOBILIZATION	LUMP SUM	LUMP SUM			
0020	517	00101 CONSTRUCTION SURVEYING CONSTRUCTION	LUMP SUM	LUMP SUM			
0030	301	00110 CLEARING AND GRUBBING	LUMP SUM	LUMP SUM			
0040	303	00120 REGULAR EXCAVATION	438.000 CY				
0050	305	00140 BORROW EXCAVATION	53.000 CY				
0060	308	10128 AGGR. BASE MATL. TY. I NO. 21B	207.000 TON				
0070	315	10607 ASPHALT CONCRETE TY. SM- 12.5A	637.000 TON				
0080	315	10610 ASPHALT CONCRETE TY. IM- 19.0A	86.000 TON				
0090	515	10628 FLEXIBLE PAVEMENT PLANING 0" - 2"	5,272.000 SY				
0100	315	11070 SAW-CUT ASPH CONC FULL DEPTH	1,114.000 LF				
0110	502	12020 STD. CURB CG-2	207.000 LF				
0120	502	12022 RADIAL CURB CG-2	15.000 LF				
0139	502	12700 STD. COMB. CURB & GUTTER CG-7	68.000 LF				

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				Dollars	Cents	Dollars	Cents
0140	502	12610 RADIAL COMB. CURB & GUTTER CG-6	50.000 LF	_____	_____	_____	_____
0150	502	12710 RADIAL COMB. CURB & GUTTER CG-7	46.000 LF	_____	_____	_____	_____
0160	502	12940 ENTRANCE GUTTER CG-9D	94.000 SY	_____	_____	_____	_____
0170	504	13108 CG-12 DETECTABLE WARNING SURFACE	4.000 SY	_____	_____	_____	_____
0180	504	13220 HYDRAULIC CEMENT CONC. SIDEWALK 4"	28.000 SY	_____	_____	_____	_____
0190	ATTD	13224 EXPOSED AGGR. SIDEWALK 4"	76.000 SY	_____	_____	_____	_____
0200	502	21110 MEDIAN STRIP MS-1A	187.000 SY	_____	_____	_____	_____
0210	511	24100 ALLAYING DUST	20.000 HR	_____	_____	_____	_____
0220	512	24152 TYPE 3 BARRICADE 8'	3.000 EA	_____	_____	_____	_____
0230	512	24160 TEMPORARY (CONSTRUCTION) SIGN	368.000 SF	_____	_____	_____	_____
0240	512	24272 TRUCK MOUNTED ATTENUATOR	120.000 HR	_____	_____	_____	_____
0250	512	24278 GROUP 2 CHANNELIZING DEVICES	10,350.000 DAY	_____	_____	_____	_____

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				Dollars	Cents	Dollars	Cents
0260	512	24279 PORTABLE CHANGEABLE MESSAGE SIGN	3,024.000 HR	_____	_____	_____	_____
0270	512	24281 ELECTRONIC ARROW BOARD	600.000 HR	_____	_____	_____	_____
0280	512	24282 FLAGGER SERVICE	40.000 HR	_____	_____	_____	_____
0290	ATTD	24355 POLICE PATROL .	24.000 HR	_____	_____	_____	_____
0300	508	24410 DEMOLITION OF PAVEMENT COMBINATION	192.000 SY	_____	_____	_____	_____
0320	510	24503 REMOVE EXIST. TRAFFIC CONTROL SIGNAL	LUMP SUM	LUMP SUM	_____	_____	_____
0330	603	27101 TEMPORARY SEED	1.000 LB	_____	_____	_____	_____
0340	603	27102 REGULAR SEED	1.000 LB	_____	_____	_____	_____
0350	603	27103 OVERSEEDING	2.000 LB	_____	_____	_____	_____
0360	603	27111 HYDRAULIC EROSION CONTROL PRODUCT TYPE 2	61.000 SY	_____	_____	_____	_____
0370	603	27112 HYDRAULIC EROSION CONTROL PRODUCT TYPE 3	48.000 SY	_____	_____	_____	_____
0380	603	27230 FERTILIZER NITROGEN - N	1.000 LB	_____	_____	_____	_____
0390	603	27231 FERTILIZER PHOSPHOROUS - P	1.000 LB	_____	_____	_____	_____

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Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
0400	603	27232 FERTILIZER POTASSIUM - K	1.000 LB	_____	_____	_____	_____
0410	603	27250 LIME	0.050 TON	_____	_____	_____	_____
0420	303	27430 SILTATION CONTROL EXCAVATION	30.000 CY	_____	_____	_____	_____
0430	303	27451 INLET PROTECTION TYPE A	1.000 EA	_____	_____	_____	_____
0440	303	27461 INLET PROTECTION TYPE B	3.000 EA	_____	_____	_____	_____
0450	520	41101 RELOCATE UTILITY RELOCATION	LUMP SUM	LUMP SUM	_____	_____	_____
0460	701	50108 SIGN PANEL	298.000 SF	_____	_____	_____	_____
0470	700	50340 RELOCATE EXISTING 1 POST GROUND MOUNTED SIGN PANEL	2.000 EA	_____	_____	_____	_____
0480	700	50430 SIGN POST STP-1, 2", 14 GAUGE	60.000 LF	_____	_____	_____	_____
0490	700	50432 SIGN POST STP-1, 2 3/16", 10 GAUGE	12.000 LF	_____	_____	_____	_____
0500	700	50434 SIGN POST STP-1, 2 1/2", 10 GAUGE	12.000 LF	_____	_____	_____	_____
0510	700	50485 CONCRETE SIGN FOUNDATION STP-1, TYPE A	7.000 EA	_____	_____	_____	_____

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Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
0520	700	50486 CONCRETE SIGN FOUNDATION STP-1, TYPE B	1.000 EA	_____	_____	_____	_____
0530	700	50490 CONCRETE SIGN FOUNDATION STP-1, TYPE F	9.000 EA	_____	_____	_____	_____
0540	510	50600 REMOVE TY.I SIGNS	12.000 EA	_____	_____	_____	_____
0560	700	51170 ELECTRICAL SERVICE SE-5	1.000 EA	_____	_____	_____	_____
0590	700	51212 PEDESTAL POLE PF-2 12'	4.000 EA	_____	_____	_____	_____
0600	700	51238 CONCRETE FOUNDATION SIGNAL POLE PF-8	22.000 CY	_____	_____	_____	_____
0610	700	51240 CONCRETE FOUNDATION PF- 2	4.000 EA	_____	_____	_____	_____
0620	700	51245 CONCRETE FOUNDATION CF-1	1.000 EA	_____	_____	_____	_____
0640	700	51478 SIGNAL MAST ARM POLE MP- 3, TYPE C	2.000 EA	_____	_____	_____	_____
0650	700	51487 MAST ARM 49'	2.000 EA	_____	_____	_____	_____
0670	700	51489 MAST ARM 65'	1.000 EA	_____	_____	_____	_____
0680	700	51490 MAST ARM 70'	1.000 EA	_____	_____	_____	_____
0690	703	51523 EVP DETECTION SYSTEM 3- WAY	1.000 EA	_____	_____	_____	_____

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Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
0700	703	51525 EVP DETECTOR CABLE	750.000 LF	_____	_____	_____	_____
0710	703	51540 LOOP DETECTOR AMPLIFIER	4.000 EA	_____	_____	_____	_____
0720	703	51541 DETECTOR RACK MOUNTED INDUCTIVE LOOP AMPLIFIER	5.000 EA	_____	_____	_____	_____
0730	700	51602 14/4 CONDUCTOR CABLE	850.000 LF	_____	_____	_____	_____
0740	700	51607 14/7 CONDUCTOR CABLE	1,870.000 LF	_____	_____	_____	_____
0760	700	51615 14/1 ENCLOSED COND. CABLE	3,710.000 LF	_____	_____	_____	_____
0770	700	51700 14/2 CONDUCTOR CABLE SHIELDED	2,440.000 LF	_____	_____	_____	_____
0780	703	51834 HANGER ASSEMBLY SMB-2, ONE WAY	4.000 EA	_____	_____	_____	_____
0800	703	51840 HANGER ASSEMBLY MAST ARM HANGER ASSEMBLY SM-3 (IN-LINE)	15.000 EA	_____	_____	_____	_____
0810	703	51912 LOOP SAW CUT 3/8"	1,490.000 LF	_____	_____	_____	_____
0820	703	51913 LOOP SAWCUT 5/8"	140.000 LF	_____	_____	_____	_____
0821	ATTD	52002 TRAFFIC SIGNALIZATION ADVANCED TRANSPORTATION CONTROLLER (ATC)	1.000 EA	_____	_____	_____	_____

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				Dollars	Cents	Dollars	Cents
0822	ATTD	52002 TRAFFIC SIGNALIZATION ADVANCED TRANSPORTATION CONTROLLER (ATC) CABINET (5-DOOR, 32 OUTPUT, HV)	1.000 EA	_____	_____	_____	_____
0830	703	51934 REMOVE EXISTING FOUNDATION	3.000 EA	_____	_____	_____	_____
0860	512	51955 TEMPORARY TRAFFIC CONTROL SIGNAL TEMP SIGNAL	LUMP SUM	LUMP SUM	_____	_____	_____
0870	703	51994 UNINTERRUPTIBLE POWER SUPPLY TYPE 2	1.000 EA	_____	_____	_____	_____
0880	703	51995 UNINTERRUPTIBLE POWER SUPPLY BATTERY PACK	1.000 EA	_____	_____	_____	_____
0900	ATTD	52002 TRAFFIC SIGNALIZATION APS PEDESTRIAN ACTUATION (PA-2)	4.000 EA	_____	_____	_____	_____
0910	703	52002 TRAFFIC SIGNALIZATION TRAFFIC SIGNAL HEAD SECTION (12", HVSB BACKPLATE	50.000 EA	_____	_____	_____	_____
0920	703	52404 PEDESTRIAN SIGNAL HEAD SP-9	4.000 EA	_____	_____	_____	_____
0930	704	54032 TYPE B CLASS I PVMT LINE MRKG 4"	2,410.000 LF	_____	_____	_____	_____
0940	704	54034 TYPE B CLASS I PVMT LINE MRKG 6"	265.000 LF	_____	_____	_____	_____

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Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
0950	704	54037 TYPE B CLASS I PVMT LINE MRKG 8"	196.000 LF	_____	_____	_____	_____
0960	704	54042 TYPE B CLASS I PAVE. LINE MARKING 24"	95.000 LF	_____	_____	_____	_____
0970	704	54392 PVMT MESSAGE MARK. ONLY TY B CL I	5.000 EA	_____	_____	_____	_____
0980	704	54572 PVMT SYMB MRKG THRU ARROW TY B, CL II	2.000 EA	_____	_____	_____	_____
0990	704	54574 PVMT SYMB MRKG SGL TURN ARROW TY B, CL I	18.000 EA	_____	_____	_____	_____
1000	700	55080 8 CONDUCTOR CABLE	100.000 LF	_____	_____	_____	_____
1010	700	55126 CONDUCTOR CABLE, NO. 8 EGC	460.000 LF	_____	_____	_____	_____
1020	700	55385 ELECTRICAL SERVICE WORK PAD	1.000 EA	_____	_____	_____	_____
1030	700	55587 JUNCTION BOX JB-S2	5.000 EA	_____	_____	_____	_____
1040	700	55588 JUNCTION BOX JB-S3	1.000 EA	_____	_____	_____	_____
1050	700	56014 ELECT. SER. GRD. ELECTRODE 10'	5.000 EA	_____	_____	_____	_____
1060	700	56021 1" PVC CONDUIT	40.000 LF	_____	_____	_____	_____
1070	700	56032 2" METAL CONDUIT	10.000 LF	_____	_____	_____	_____

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Proposal Line Number	Spec No.	Item ID Description	Approximate Quantity and Units	Unit Price		Bid Amount	
				Dollars	Cents	Dollars	Cents
1080	700	56052 BORED CONDUIT 4"	300.000 LF	_____	_____	_____	_____
1090	700	56053 2" PVC CONDUIT	50.000 LF	_____	_____	_____	_____
1100	700	56054 3" PVC CONDUIT	40.000 LF	_____	_____	_____	_____
1110	700	56055 4" PVC CONDUIT	30.000 LF	_____	_____	_____	_____
1120	700	56200 TRENCH EXCAVATION ECI-1	120.000 LF	_____	_____	_____	_____
1130	700	56205 TEST BORE	2.000 EA	_____	_____	_____	_____
1140	ATTD	59050 COMMUNICATION EQUIP. WIRELESS CELLULAR ROUTER	1.000 EA	_____	_____	_____	_____
1150	ATTD	70510 ENVIR. PROTECTION MANAGEMENT OF LOW- LEVEL PETROLEUM- CONTAMINATED SOIL	8.400 CY	_____	_____	_____	_____

Section: 0001 Total: _____

Total Bid: _____

Determination of Major Items

Item Number	Item Description
10607	ASPHALT CONCRETE TY. SM-12.5A

Bid Items Eligible For Fuel Adjustment

Instructions: This form shall be completed in accordance with the Special Provision for Optional Adjustment for Fuel. If you choose to have Fuel Adjustment applied to any of the items listed below, write the word "Yes" in the "OPTION" column beside the item. The form must be signed, dated, and submitted to the Contract Engineer within the timeframe required in the Special Provision.

SECTION: 0001 REGULAR BID ITEMS

Item Number	Item Description	Fuel Factor gal/unit	Option
00120	REGULAR EXCAVATION	0.290	_____
00140	BORROW EXCAVATION	0.290	_____
10128	AGGR. BASE MATL. TY. I NO. 21B	0.600	_____
10607	ASPHALT CONCRETE TY. SM-12.5A	3.500	_____
10610	ASPHALT CONCRETE TY. IM-19.0A	3.500	_____
10628	FLEXIBLE PAVEMENT PLANING 0" - 2"	0.071	_____
24410	DEMOLITION OF PAVEMENT COMBINATION	0.200	_____
27430	SILTATION CONTROL EXCAVATION	0.290	_____

Date: _____

Signature: _____

(Firm or Corporation)

(Vendor No.)

Bid Items Eligible For Steel Price Adjustment

Instructions: This form shall be completed in accordance with the Special Provision. If you choose to have Steel Price Adjustment applied to any of the items listed below, write the word "Yes" in the "OPTION" column beside the item. The form must be signed, dated, and submitted to the Contract Engineer within the timeframe required in the Special Provision.

SECTION: 0001

REGULAR BID ITEMS

Item Number	Item Description	Option
50430	SIGN POST STP-1, 2", 14 GAUGE	_____
50432	SIGN POST STP-1, 2 3/16", 10 GAUGE	_____
50434	SIGN POST STP-1, 2 1/2", 10 GAUGE	_____
51478	SIGNAL MAST ARM POLE MP-3, TYPE C	_____
51487	MAST ARM 49'	_____
51489	MAST ARM 65'	_____
51490	MAST ARM 70'	_____

Date: _____

Signature: _____

(Firm or Corporation)

(Vendor No.)

ORDER NO.: C53
CONTRACT ID. NO.: C0000109471C01

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SS703-002016-01

December 14, 2018

VIRGINIA DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL SPECIFICATION FOR
SECTION 703—TRAFFIC SIGNALS

SECTION 703—TRAFFIC SIGNALS of the Specifications is amended as follows:

~~Section 703.02(d) Signal Heads~~ is amended to replace the fourth and fifth paragraphs with the following:

Backplates shall be included with all vehicle traffic control signal heads unless otherwise specified in the Contract. Backplates shall be specifically manufactured for the type and brand of traffic signal heads used or shall be of a universal design expressly manufactured for various types and brands of traffic signal heads. Backplates shall have a border width of 5 inches, shall be without louvers, and be of one-piece construction with the exception of those for five-section cluster signal heads, which may be a maximum of three pieces. All outside corners on backplates shall have a 3-inch radius. Black Signal Backplates (both sides) and signal leveling attachments shall be flat black. Black signal backplates shall be aluminum or aluminum composite. Aluminum and aluminum composite shall conform to Section 238.

High-Visibility Signal Backplates (HVSBs) shall be provided if specified in the plans. HVSBs may be aluminum or aluminum composite; ABS plastic shall not be used. HVSBs shall be preassembled by the manufacturer in accordance with Section 238 of the Specifications.

~~Section 703.03(e)1a~~ is replaced with the following:

Unless otherwise directed by the Engineer, backplates shall be attached with either bolts, washers, and lock nuts, or with self tapping screws and washers.

The minimum number of fasteners connecting the backplate to the traffic signal head shall be four for each 12-inch traffic signal head section. Fasteners and all miscellaneous hardware shall be stainless steel unless otherwise directed by the Engineer. The fasteners shall be a minimum 3/16-inch diameter and 1/2-inch long.

When HVSBs are to be installed on new signal heads, cutting the backplate is not required unless otherwise directed by the Engineer.

~~Section 703.04—Measurement and Payment~~ is amended to replace the thirteenth paragraph with the following:

~~Traffic Signal Head Section~~ will be measured in units of each for the LED module size and backplate type specified and will be paid for at the Contract each price. This price shall include mountings, molded terminal block, visor, backplate, retroreflective sheeting (if required), fittings, realignments, and LED module.

~~Section 703.04—Measurement and Payment~~ is amended by revising the Pay Item Table as follows:

The following pay item is removed:

Pay Item	Pay Unit
Traffic signal head section (Size and type)	Each

The following pay item is inserted:

Pay Item	Pay Unit
Traffic Signal Head Section (LED module size, backplate type)	Each

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VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
CELLULAR ROUTER

September 1, 2017
0003-036-610, C501

I. DESCRIPTION

~~This work shall consist of furnishing, installing, and fully integrating cellular router equipment in accordance with this Special Provision, the Plans, or as directed by the Engineer. Cellular router equipment shall be used for bi-directional data communications between ITS traffic field devices and the Region's Traffic Operations Center (TOC).~~

II. MATERIALS

~~Equipment shall conform to the National Electrical Code (NEC), the National Electrical Safety Code (NESC), Underwriter's Laboratories (UL), and all local safety codes in effect on the date of the contract advertisement.~~

III. EQUIPMENT

~~The cellular router shall be Restriction of Hazardous Substance directive (ROHS) compliant and FCC approved. The cellular router shall be certified by the PCS Type Certification Review Board (PTCRB). The cellular router shall support at a minimum the following host interfaces: four Ethernet 10/100 Mbps RJ-45, two serial ports (at least one DB-9 port and one RJ-45 asynchronous serial ports), one USB 2.0 (Mini-B5), two built-in SIM trays, and 2 SMA ports for dual cellular/LTE antenna operation. The cellular router shall also support the following antenna connections: Primary 50 Ohm SMA, and Rx Diversity: 50 Ohm SMA. Cellular routers shall be Digi WR44-L5A3-CE1-RD or approved equal.~~

~~1. Electrical Specifications~~

~~The cellular router shall operate on North American AC 120 volt, 60 Hertz, have an AC adapter, and support a locking power connector. The cellular router shall operate at both standard 12 and 24 VDC power systems, and shall function without impairment from a sustained DC supply of 9 to 36 Volts DC.~~

~~2. Environmental Specifications~~

~~Cellular router equipment shall be hardened for field cabinet conditions. Cellular router shall have a minimum operating temperature range of 40°F to 167°F with a maximum non-condensing relative humidity as defined in the environmental requirements section of the NEMA TS 2 standard. The unit shall use passive cooling of the enclosure with no requirement for internal fans.~~

~~3. Physical Specifications~~

~~The unit shall be DIN-rail or shelf mountable. The enclosure shall be suitable for mounting in confined spaces and of rugged design and constructed of metal on all sides to protect all electronic components. The height of the enclosure shall permit mounting on an existing equipment tray with limited vertical clearance. All electronics that comprise the router (including cellular data modems, etc.) shall be fully contained within the enclosure.~~

~~4. Network and Routing Specifications~~

~~The cellular router shall support the following:~~

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PROTOCOLS:

~~HTTP, HTTPS, FTP, SFTP, SSL, SMTP, SNMP (v1/v2c/v3), SSH, Telnet and CLI for web management; SMS management, protocol analyzer, ability to capture PCAP for use with Wireshark; DynDNS; Dynamic DNS client compatible with BIND9/No-IP/DynDNS~~

SECURITY/VPN:

~~Stateful inspection firewall with scripting, address and port translation; VPN: IPSec with IKEv1, IKEv2, NAT Traversal; SSL, SSLv2, FIPS 197, Open VPN client and server; PPTP, L2TP; Concurrent VPN Tunnels Minimum five (5).~~

Cryptology:

~~SHA-1, MD5, RSA.~~

Encryption:

~~DES, 3DES and AES up to 256-bit.~~

Authentication:

~~RADIUS, TACACS+, SCEP for X.509 certificates; Content Filtering (via 3rd party) ; MAC Address Filtering; VLAN support; Ethernet Port Isolation.~~

ROUTING/FAILOVER:

~~IP pass-through ; NAT, NAT with IP Port Forwarding; Ethernet Bridging; GRE; Multicast Routing.~~

Routing Protocols:

~~PPP, PPPoE, RIP (v1, v2) OSPF, SRI, BGP, iGMP routing (multicast); RSTP (Rapid Spanning Tree Protocol).~~

IP Failover:

~~VRRP, VRRP+TM; Automatic failover/failback to second GSM network/Standby APN
OTHER PROTOCOLS DHCP; Dynamic DNS client compatible with BIND9/No-IP/DynDNS;
QoS via TOS/DSCP/WRED.~~

~~The VPN function must not require the installation of any special VPN client software on LAN-connected computing devices served by the gateway. The router shall be configurable as an SNTP server to distribute network time to its LAN connected clients.~~

~~5. Cellular Communications Specifications~~

~~The cellular interface shall support LTE Bands 2, 4, 5, 13, 17 and 25 in a single cell module, and automatically fall back to 3G and 2G technology when LTE is not available. The router shall be certified on Verizon and AT&T networks and shall support automatic failover to a secondary carrier when dual SIM cards are used.~~

~~6. Certifications and Security~~

~~The router shall comply with the following:~~

- ~~● FCC Part 15B certification~~
- ~~● UL 60950 safety certification~~
- ~~● CISPR 22, EN55024 and EN55022 for emissions/ immunity~~
- ~~● EN 300 019 2-5 for vehicular vibration & shock~~
- ~~● ISO7637-2 for compatibility with conducted transients~~

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The router shall support SSL v1-3, MAC address filtering, and Simple Certificate Enrollment Protocol (SCEP). A rules-based stateful firewall shall restrict the type of traffic that the router can transmit or receive on any interface based on a combination of IP address, service type, protocol type, port number and IP flags. Local and remote access to the administrative interface of the router shall be secured by password-protected login.

~~7. Management Capability~~

~~The Router shall have capability to allow centralized management of gateways, ease of integration via APIs, elastic scalability, commercial-grade reliability and industry-leading security policies. Every router shall be accessible remotely, and its status and configuration viewed and updated through a graphical user interface (GUI) through an individual connection. The management system shall be capable of automatically upgrading software at individual routers, a group of routers, or all routers, as specified by the system administrator.~~

~~8. Antenna Connections:~~

~~The antenna connectors shall be brass with a gold plated brass contact. Connectors shall meet MIL-Std. 202 and include weatherproofing materials to prevent moisture from entering the cabinet. RF antenna connectors shall be threaded or have a locking mechanism to prevent accidental removal of associated cables. Coaxial jumper cables shall have appropriate male end connectors to mate properly between the N-Female bulkhead connector and SMA-Female router connection points.~~

~~9. External Antennae~~

~~Two ruggedized LTE antennae compatible with the cellular router shall be provided for external mounting to the associated ITS controller cabinet or pole. Antennae shall meet the following specifications:~~

- ~~1. Color: Black~~
- ~~2. Material: UV resistant ABS plastic~~
- ~~3. Mount Style: ¾" NMO~~
- ~~4. Operating Temperature -40°C to 85°C~~
- ~~5. Gain: 0-4 dBi~~
- ~~6. Minimum frequency range: 700-2700 MHz (4G LTE / 3G)~~
- ~~7. Maximum Power: 100 W~~
- ~~8. Impedance: 50 Ohms~~
- ~~9. Maximum Dimensions: 4" (H) x 2" (Dia)~~
- ~~10. Radiation Pattern: Omnidirectional~~
- ~~11. Cabinet Bulkhead Connector: NMO Thru-hole mounted bulkhead connector with Type N female connector on the interior of the cabinet, installed with a rubber O-ring to prevent moisture from entering the cabinet from the top of the cabinet.~~

IV. PROCEDURES

- ~~—The Contractor shall install all equipment according to the latest version of the manufacturer's installation procedures and industry accepted installation standards, codes, and practices, or as directed by the Engineer. All materials and installation practices shall be in accordance with the applicable OSHA requirements as found in 29 Code of Federal Regulations (CFR) Part 1926, Safety and Health Standards for Construction.~~
- ~~—The Contractor shall be responsible for supplying and properly installing the field router and making all field connections according to manufacturer's recommendations.~~

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~~**Integration:** Prior to integration with the Department's existing system, the Contractor shall conduct field-based tests as well as remote tests from the TOC to verify proper operation of all new equipment. These tests shall be conducted with Contractor-provided computers, hardware, and software. The Contractor shall notify the Department in writing when new equipment is ready for integration. Any Contractor-provided computers will be disconnected at that time and retained by the Contractor.~~

~~The Contractor shall submit all necessary equipment documentation and demonstrate an ability to integrate the new equipment with the TOC's existing systems. If the TOC concurs with the equipment and configuration, the Contractor shall work with the TOC Systems Integrator to integrate the new equipment. The Contractor shall work with the TOC Integrator to resolve any integration issues. Contractor assistance shall include, but is not limited to, protocol description, vendor support, hardware interface documentation, configuration support, device or system testing and verification, and loaner equipment for the integration test bed. The Contractor shall be responsible for all costs associated with this integration.~~

~~— The Contractor shall troubleshoot the system and pinpoint integration problems involving Contractor-supplied equipment. The Contractor shall remedy any deficiency discovered during integration attributable to Contractor-supplied equipment or software, Contractor negligence, poor workmanship, or other fault that violates requirements set forth in the contract documents or drawings. The Contractor shall not be responsible for modifying or debugging any Department-supplied hardware or software.~~

~~— **Communications System Operational Testing:** The Contractor shall submit a written test plan for approval by the TOC at least 2 weeks prior to the start of a mutually agreed-upon test window.~~

~~— **Warranty:** Provide a minimum 5 year warranty with each router installation on all equipment to ensure that all products are free of manufacturing, design, material, and workmanship defects. The warranty period shall begin on the date of final acceptance of the work as defined in Section 108.09 of the Specifications.~~

~~**V. MEASUREMENT AND PAYMENT**~~

~~**Cellular Router** will be measured in units of each and will be paid for at the Contract each price. This price shall include furnishing and installing the cellular router, antennae, fittings, and miscellaneous cabling; installing and testing operational software and firmware; furnishing supplies, technical support, personnel training, shop drawings, and documentation; and coordinating leased services required to complete the work. Seventy percent of the Contract price will be paid upon delivery of materials, software protocols, and documentation; installation of the cellular router and all wiring for a fully operational cellular router; and successful completion of the field acceptance tests. Thirty percent of the Contract price will be paid upon successful integration with the VDOT Traffic Operations Center and successful completion of the subsequent Communications and System Operational Test.~~

~~Payment will be made under:~~

Pay Item	Pay Unit
Cellular Router	Each

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VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
**ADVANCED TRANSPORTATION CONTROLLER (ATC) CABINET -
5-DOOR CONFIGURATION**

April 10, 2018
0003-036-610, C501

I. DESCRIPTION

This Special Provision describes the Advanced Transportation Controller (ATC) Cabinet— 5-Door Configuration for the Virginia Department of Transportation. The ATC Cabinet— 5-Door Configuration shall conform to the ITS Cabinet Standard v01.02.17b dated November 16, 2006 except as required herein.

The ATC Cabinet— 5-Door Configuration shall include one ITS Housing #3 type cabinet, two Mounting Cages, and be mounted on an oversized base adapter. Facing the front, the right rack cage, Segment A, shall be the ATC cabinet side with modular and interchangeable ATC assemblies interconnected through an advanced serial data bus. The left rack cage, Segment B, shall include the Auxiliary Communications Panel, shelving for the backup power system and a power distribution unit for communications devices.

Common parts for the ATC Cabinet, Segment A, shall include: Service Assembly (SA); Input Assembly (IA); Output Assembly (OA); Power Assembly (PA) including the Alternating Current (AC) Clean Power Bus; combination Serial Bus #1 (SB1)/Serial Bus #2 (SB2) and DC Power Bus; Field Input Termination Assembly (FITA); and Field Output Termination Assembly (FOTA).

II. EQUIPMENT

1. Composition

Unless otherwise specified the ATC Cabinet— 5-Door Configuration shall be furnished, ready for operation with the following composition.

The ATC Cabinet— 5-Door Configuration shall consist of Housing #3 and two Mounting Cages as identified as Segment A and Segment B.

Segment A shall consist of:

- Service Assembly
- Power Assembly
- (2) Input Assembly
 - Input Test Panel Assembly
- (2) Field Input Termination Assembly
- Output Assembly (16 or 32)
- Field Output Termination Assembly (16 or 32)

The Power Assembly shall consist of:

- DC Power Supply
- AC Clean Power Bus
- SB1/SB2 and DC Power Bus
- Auxiliary Input/Output Assembly
- Advanced Detection Assembly

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Segment B shall consist of:

- Auxiliary Communication Panel
- Power Distribution Unit
- (2) Shelf – Type I
- (2) Shelf – Type II

2. General Requirements

All Assemblies, switches, terminal blocks, and connectors in the ATC Cabinet shall be clearly and permanently labeled. All fuses, circuit breakers, switches (except police panel switches) and indicators shall be readily visible and accessible when the ATC Cabinet front door is open. All circuit breakers located on the rack shall have covers to prevent accidental tripping.

The marker strips shall be made of material that can be easily and legibly written on using a pencil or ballpoint pen. Marker strips shall be located immediately below the item they are to identify and must be clearly visible with the items installed.

Guides (top and bottom) shall be provided for assembly plug-in units. The guides shall begin 1/2 inch from the assembly front panel face.

High-voltage components (over 50 V) shall not be exposed per National Electric Code (NEC).

When servicing Segment A of the ATC Cabinet, the Input Assembly, Output Assembly, and Controller shall be replaceable in the flash mode condition, without putting the intersection in a dark condition.

All Assemblies shall be modular with pluggable cabling. All cabling shall be sufficient length to allow for mounting the assemblies in any position within the rack. Assemblies shall not be hardwired. Wire raceways shall be integrated as part of Segment A of the ATC Cabinet allowing for neat internal and field wiring. Do not block, hinder, or inhibit the installation of standard rack mounted equipment with wires and cables for the full height and width of the rack chassis.

A momentary push button switch labeled "24 VDC BYPASS" shall be located on the front of the Output Assembly that, when pressed, energizes 24 VDC to the High Density Switch Packs during flash mode for troubleshooting purpose.

A. Environmental and Electrical

Ensure all components properly operate within the following limits:

- Applied Line Voltage: 90 to 135 VAC
- Frequency: 60 (± 3.0) Hertz
- Humidity: 5% to 95%
- Ambient Temperature: -35°F to +165°F
- Shock - Test in accordance with MIL-STD-810G Method 516.6
- Vibration - in accordance with MIL-STD-810G Method 514.

B. Assemblies and Files

All assemblies and files shall be mounted on the cage mounting rails per cabinet model detail. In Segment A, a clear area for the ATC controller unit shall be provided. The area shall extend 1-1/2 in. in front of and 16 in. behind the front EIA mounting angles.

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C. Cabinet Shipping Requirements

The cabinet shall be delivered mounted with bolts on a ply board shipping pallet. The cabinet shall be enclosed in a slipcover cardboard packing shell. The housing doors shall be blocked to prevent movement during transportation.

D. Fasteners

All bolts, nuts, washers, screws (size 8 or larger), hinges, and hinge pins shall be stainless steel unless otherwise specified.

E. Protection

All conductors, terminals, and parts which could be hazardous to maintenance personnel shall be protected with suitable insulating material.

3. ATC Cabinet Housing

A. General

The ATC Cabinet Housing shall be based on the ITS Housing #3 enclosure and shall include, but not be limited to, the following:

- Enclosure & Doors
- Gasketing
- Lifting Eyes & External Bolt Heads
- Door Latches & Locks
- Housing Ventilation
- Cage Supports and Mounting
- Door Hinges & Catches
- Police Panel
- Aluminum Surfaces

B. Housing Dimensions

The cabinet shall be 66-3/8 inches high by 44-1/2 inches wide by 26 inches deep ($\pm 1/2$ inch). The front-to-back cabinet dimensions shall not exceed 32 inches deep, including the door handles, louvers, and roof overhang.

C. Exterior Housing - Aluminum Surface Protection

An aluminum surface protection shall be applied to the exterior surface of the cabinet housing. The surface protection shall be ANTI-GRAFFITI Paint.

D. Lifting Eyes and Exterior Bolt Heads

The housing shall be provided with two lifting eyes for placing the cabinet on its foundation. Lifting eyes shall be mounted on the sides of the cabinet, centered, and extend above the top of the cabinet to provide unobstructed access to the eyes. Each eye opening shall have a minimum diameter of 3/4 inches. The lifting eyes shall be able to lift the cabinet. All bolt heads shall be tamperproof type.

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E. Door Latches and Locks

(1) General

Five vertically hinged doors shall be mounted on the cabinet for interior access. Three doors, two vertically aligned on the left and one on the right, shall be located on the front face. Two doors shall be located on the rear face of the cabinet.

(2) Enclosure Door Frames and Door Seals

The right door on the front face and both doors on the rear face of the cabinet shall be 58-3/8 inches high by 22-1/4 inches wide ($\pm 1/2$ inch). Each of these door openings shall not be less than 56-3/8 inches high by 20-1/8 inches wide ($\pm 1/2$ inch).

The upper left face door, the fourth door, shall be 34 inches high by 22-1/8 inches wide ($\pm 1/2$ inch) with a door opening not less than 30 inches high by 20-1/4 inches wide ($\pm 1/2$ inch).

The lower left face door, the fifth door, shall be 24 inches high by 22-1/8 inches ($\pm 1/2$ inch) wide with a door opening not less than 20 inches high by 20-1/4 inches wide ($\pm 1/2$ inch).

(3) Latching Handles

The latching handles shall have provision for padlocking in the closed position. Each handle shall be 3/4-inch minimum diameter stainless steel with a minimum of 1/2-inch shank. The padlocking attachment shall be placed at 4 inches from the handle shank center. An additional 4-inch minimum gripping length shall be provided.

Door handles shall be vertical in the close position. All door handles shall rotate in a direction towards the door hinges, to open the cabinet door.

(4) Latch and Lock Mechanism

The latching mechanism shall be a three-point draw roller type. The pushrods shall be turned edgewise at the outward supports and have a cross section of 1/4 inch thick by 3/4 inch wide minimum. When the door is closed and latched, the door shall be locked. The lock and lock support shall be rigidly mounted on the door. The lock shall be mounted in the upper quadrant, above the handle when in its full open position. In the locked position, the bolt throw shall extend a minimum of 0.25 inch (± 0.03125 inches) into the latch cam area. A seal shall be provided to prevent dust or water entry through the lock opening.

(5) Lock and Keys

The cabinet door locks shall be mounted to the cabinet with four bolts and the tumbler shall be keyed to a 2 type. One key shall be supplied with each lock. The keys shall be removable in the locked position only. A swing away cover shall be placed over the key entrance to protect the lock mechanism.

The fifth door shall be equipped with a lock compatible with VDOT District interface box door locks, and the lock shall be keyed for a master communication key. Two keys shall be furnished with each door lock. Each communication key shall have a minimum shaft length of 1-3/4 inches.

F. Housing Ventilation

Housing ventilation shall include intake, exhaust, filtration, and thermostat controlled fans.

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(1) Door Ventilation

The front facing right door and the rear facing right door shall be provided with louvered vents. The louvered vent depth shall be a maximum of 1/4 inch. A removable and reusable air filter shall be housed behind the door vents. The filter filtration area shall cover the vent opening area. A filter shell shall be provided that fits over the filter providing mechanical support for the filter. This shell shall be louvered to direct the incoming air downward. The shell sides and top shall be bent over a minimum of 1/4 inch to house the filter. The filter resident in its shell shall be held firmly in place with a bottom trough and spring loaded upper clamp. No incoming air shall bypass the filter. The bottom filter bracket shall be formed into a waterproof sump with drain holes to the outside housing.

(2) Intake and Filter

The intake (including filter with shell) and exhaust areas shall pass a minimum of 120 cu. ft. of air per minute.

(3) Fans

Four fans shall be mounted within the housing and protected with a finger guard. Each electric fan shall be equipped with ball or roller bearings and shall have a minimum capacity of 100 cu. ft. of free air delivery per minute. The fan shall be fastened to the cabinet with two thumb screws which shall not be fastened in a manner that requires any tools for removal or installation.

(4) Temperature Controlling Panel

Temperature Controlling Panels shall control one fan and include one thermostat, an on/off switch, fan test button, and fuses. Each fan shall be thermostatically controlled and shall be manually adjustable to turn on between 32°F and 140°F with a differential of not more than 20 degrees between automatic turn on and off. Protect the fan circuit at 125% of the fan motor ampacity. Grade the manual adjustment in 20°F increments scale. Temperature Controlling Panels shall be installed in the same section of the cabinet as the fans which they control.

G. Hinges & Door Catches

(1) Hinges

Stainless steel hinges (two bolts per leaf) shall be provided to bolt the enclosure to the doors. Provide two hinges for the fourth and fifth doors, and provide four hinges for all remaining doors. Each hinge shall be 3-1/2 inch minimum length and have a fixed pin. The pin ends shall be welded to the hinge and ground smooth. The pins and bolts shall be covered by the door edge and not accessible when the door is closed.

(2) Door Catches

All five doors shall be provided with catches to hold the door open at both 90 and 165 (±10) degrees. The catch shall be 0.375 inch minimum diameter aluminum rods. The catches must be capable of holding the door open at 90 degrees in a 60 mph wind acting at an angle perpendicular to the plane of the door.

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H. Police Panel

(1) Manual Advance Cable

Each cabinet shall be provided with an interval advance cord, six feet long, with a weatherproof manual police push button.

(2) Toggle Power Switches

The Police Panel shall include three DPST switches. **Provide one switch "SIGNAL ON/OFF" and one switch labeled "FLASH/AUTO"**. Provide the MANUAL CONTROL ENABLE ON-OFF switch and a receptacle for the INTERVAL ADVANCE cord.

All switch shall be "ON" or "AUTO" when in the UP position.

The Police Panel switches shall be individually wired through factory molded connectors which allow the switches to be disconnected and not usable, as desired by the Department. These connectors shall be wired in such a way to provide full cabinet operation when any or all Police Panel switches are connected or disconnected.

I. Cabinet Lights

The cabinet shall include nine LED lighting fixtures providing 350 to 380 lumens each. One light shall be mounted inside the top portion of each cabinet door. Two lights shall be mounted inside the front center structural member, equally spaced. Two lights shall be mounted inside the rear center structural member, equally spaced.

J. Door Switches

Door actuated switches shall be installed on each cabinet door to turn on the cabinet lights when any of the doors are opened. There shall also be manual switches installed to activate and deactivate the lights.

Additional switches of the same type, shall be installed on each door and the police panel door, and wired as inputs to the ATC controller through SB1 or SB2. These switches will be used to provide the "Door Open" alarm when any cabinet door is opened.

K. Drawer Shelf Unit

Provide a 2U, telescopic slide out drawer to store documents. Mount the Drawer Shelf Unit across the front EIA rails and extend the shelf mounting brackets to the rear EIA rails. The Drawer Shelf Unit shall be provided with a non-conductive top, locking provision when fully extended and lip or handle for pulling. The drawer storage area shall have no openings when fully closed to limit rodent intrusion, and minimum dimensions shall be 16 inches wide by 14 inches long by 3 inches deep.

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L. Backup Power Confirmation Lights

The Cabinet shall include one red external LED confirmation light indicating when the traffic control system is not operating on primary service power. The LED confirmation light shall be 1 inch in diameter and located above the left rear door, 4 inches from the left edge of the cabinet, and halfway between the rear cabinet door and the top of the cabinet. The LED confirmation light shall have a durable gasket to ensure weatherproofing. The LED confirmation light shall be neatly wired to a confirmation light relay panel mounted above the Service Assembly for ease of connecting to the backup power system. This panel shall be permanently labelled and include terminal blocks for wiring. The light should be configured such that when the external LED confirmation light is on, the traffic control system is operating on backup power. When the external LED confirmation light is off, the traffic control system is operating on primary service power.

M. AC- Copper Terminal Bus

The AC- copper terminal bus shall not be grounded to the cabinet or connected to logic ground. Nylon screws with a minimum diameter of 1/4 inch shall be used for securing the bus to the service panel. The AC- copper terminal bus shall be provided with a minimum number of wiring lugs for each output channel.

If the Output Assembly is for 16 channels, a minimum of 16 available wiring lugs shall be present. If the Output Assembly is for 32 channels, a minimum of 32 available wiring lugs shall be present.

4. ATC Cabinet Assemblies

A. General

The following equipment shall be completely removable from the cabinet without removing any other equipment and using only a slotted or Phillips screwdriver:

- Service Assembly (SA)
- Power Assembly (PA)
 - DC Power Supply
 - AC Clean Power Bus
 - SB1/SB2 and DC Power Bus
 - Advanced Detection Assembly
 - Auxiliary I/O Assembly
- Input Assembly (IA)
- Input Test Panel Assembly
- Field Input Termination Assembly (FITA)
- Output Assembly (OA)
- Field Output Termination Assembly (FOTA)

B. Service and Power Assembly Overview

Power for the ATC Cabinet shall originate at the Service Assembly and extend to the Power Assembly Unit of the cabinet. The Power Assembly may be a single unit or made up of separate standalone sub-assemblies.

The Serial Bus and DC power may be distributed to the Assemblies via direct connection to the SB1/SB2 and DC Power Bus or interconnected in a daisy chain method originating at the Power Assembly.

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C. Service Assembly

The Service Assembly shall be modular, utilize no more than three vertical cage spaces, and mount across two vertical cage angles when viewed from the front. The Service Assembly shall include, at a minimum the main breaker, a 15A circuit breaker protecting a ground fault circuit interrupter (GFCI) duplex outlet, a GFCI duplex outlet, service entrance conductor landing terminals, backup power conductor landing terminals, and a pluggable Cabinet Surge Protection Device.

The Service assembly may also include the High-Density Flasher Units (HDFU's) with Serial Bus 3 interface, one convenience outlet NEMA 15-5 format, four HDFU fuses, five circuit breakers and a Raw AC+ terminal block having a minimum of five terminal screws.

D. Power Assembly Unit

(1) General

The Power Assembly Unit shall include the following sub-assemblies: the DC Power Supply, SB1/SB2 and DC Power Bus, AC Clean Power Outlets, Advanced Detection Assembly, and Auxiliary IO Assembly.

The Power Assembly may be provided as one standalone assembly coupled with a minimalized Service Assembly. The standalone assembly shall include all Service Assemble features including the High Density Flasher Units with Serial Bus 3 interface, four HDFU fuses, and circuit breakers. The standalone Power Assembly shall also include the complete features of the DC Power Supply, SB1/SB2 and DC Power Bus, AC Clean Power Outlets, Advanced Detection Assembly, and Auxiliary IO Assembly.

(2) DC Power Supply

The DC Power Supply shall be supplied with the ATC Cabinet and may be provided as a standalone sub-assembly or as an integrated part of the Power Assembly. The standalone DC Power Supply shall be modular, a 19 inch EIA rack mounted device, and provide DC voltages necessary to operate the ATC Cabinet.

The input voltage range shall be 80 to 270 VAC, 45 to 65 Hz. Provide power factor corrected features and ensure a full load power factor of 0.95 or better, reducing peak AC Line input current and associated stress on wiring. Ensure the DC Power Supply uses modern switching technology and provides full output regulation of 24 and 48 VDC across changes in AC Line voltage and output load over the full operating temperature range of -35°F to +165°F without the need for a fan. The DC Output shall be electrically isolated from AC Mains, Earth Ground, and other DC outputs.

Provide separate clear LED indicators that display green for AC input status, DC output status, and associated fuse integrity. Fuse the DC Power Supply outputs for over-current protection, protected against voltage transients by a 1500 Watt suppressor.

For 120 VAC configuration, supply a DC Power Supply rated at 168 Watts, 48 VDC at 1 Amp and 24 VDC at 5 Amps.

For Low Voltage (LV), 48 VDC configuration, supply a DC Power Supply rated at 450 Watts, 48 VDC at 8 Amps and 24 VDC at 5 Amps.

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(3) SB1/SB2 and DC Power Bus

The SB1/SB2 and DC Power Bus shall be supplied with the ATC Cabinet and may be provided as a standalone sub-assembly or as an integrated part of the Power Assembly.

The SB1/SB2 and DC Power Bus as a standalone unit shall include a minimum of eight DB25 connectors to interconnect the SB1/SB2 communication ports of the assemblies and controller. It shall include a termination circuit at the end of the connections (S8) to prevent radio frequency signal reflection. SB1/SB2 and DC Power Bus shall include one factory molded plug block to bring DC power to the SB1/SB2 and DC Power Bus; such power shall be distributed to the cabinet assemblies through eight factory molded receptacle blocks. The copper conductors for the DC voltages shall support a minimum of 10 Amps. The SB1/SB2 and DC Power Bus shall be mounted in the EIA rails and it shall swing out to provide access to the back of the assemblies mounted in the opposite side.

The SB1/SB2 and DC Power Bus as part of the Power Assembly unit shall include a minimum of two DB25 connectors marking as "IN" and "Through" to interconnect the SB1/SB2 communication ports of the next adjacent assembly and the controller. The Power Assembly shall include a minimum of five assembly power factory molded plug blocks to bring DC voltages to the assemblies.

(4) AC Clean Power Bus

The AC Clean Power Bus shall be supplied with the ATC Cabinet and may be provided as a standalone sub-assembly or as part of the Power Assembly unit. The standalone sub-assembly shall swing out to provide access to the back of the assemblies mounted in opposite side.

The AC Clean Power Bus shall include a minimum of seven single NEMA 5-15 receptacles, to provide AC clean power to the ATC controller and auxiliary devices.

(5) Advanced Detection Assembly

The Advanced Detection Assembly shall be supplied with the ATC Cabinet and may be provided as a standalone sub-assembly or as an integrated part of the Power Assembly. All necessary serial bus and power cabling shall be provided to connect the assembly to the cabinet busses.

The Advanced Detection Assembly shall include a minimum of three NEMA TS2 Port-1 (SDLC) 15 Pin connectors and used to interface with NEMA TS2 compatible detection systems and hardware. It may utilize SB1 or SB2 to interface with the controller and shall be configurable in the controller.

(6) Auxiliary Input / Output (IO) Assembly

The Auxiliary IO Assembly shall be supplied with the ATC Cabinet and may be provided as a standalone sub-assembly or as an integrated part of the Power Assembly. All necessary serial bus and power cabling shall be provided to connect the assembly to the cabinet busses.

The Auxiliary IO Assembly shall include a minimum of sixteen 24 VDC, NEMA compliant, Input and Output points. Each point can be mapped to user defined special functions to drive relays or read external device status. These I/O shall be configurable in the controller.

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E. Input Assembly (24-Channel)

The ATC Cabinet shall include two 24-Channel Input Assemblies. The upper Input Assembly will be referred to as the "I" Assembly and the lower as the "J" Assembly.

The Input Assemblies shall be a 19 inch EIA rack mounted assembly providing twelve slots of 22/44 pin PCB sockets. A Serial Interface Unit shall be provided with each assembly, in its location mated to a DIN 96-pin connector. The Serial Interface Unit shall provide interface and control between the ATC Controller and the input assemblies via system SB1/SB2. Each slot shall be capable of providing two inputs into the controller. Configure slot 11 and 12 of the J Assembly to support emergency vehicle preemption equipment. Configure these two slots in such a way as to provide sufficient power to the preemption detector modules. Input Assemblies shall be capable of supporting pedestrian push button detections through any slot, with the use of a DC Isolator.

Each Input Assembly shall be provided with an Opto Input Card. The Opto Input Card shall be equipped with four LED indicators and four toggle switches. Toggling any of the four switches will insert an input to the controller.

F. Input Test Panel Assembly

The ATC Cabinet shall include a 19 inch EIA rack mounted Input Test Panel Assembly used to place vehicle, pedestrian, or preemption calls to the ATC controller through system SB1/SB2. The Input Test Panel Assembly shall be provided with 16 toggle switches and include a LED function indicator light for each switch. Provide three positions for each switch: ON (place call), OFF (normal detector operation), and Momentary ON (place momentary call and return to normal detector operation after the switch is released). Each switch shall be permanently labelled 1 through 16. The 16 toggle switches shall be mapped to an internal Serial Interface Unit and can be addressed to Serial Interface Unit 10-13 by a separate 4 position selector switch on the front panel.

G. Field Input Termination Assembly (24-Channel)

The ATC Cabinet shall include two 24-Channel Field Input Termination Assemblies. Couple the 24-Channel Field Input Termination Assembly with the corresponding 24-Channel Input Assembly. Provide positions for landing 24, two-wire inputs and their associated earth ground wires. Ensure the Field Input Termination Assembly has positions for 12 Detection Module Suppressors. Supply the Detection Module Suppressors with the cabinet. Mount the 24-Channel Field Output Termination Assembly across the EIA rails. Ensure the 24-Channel Field Output Termination Assembly swings down to provide access to the back of the assemblies mounted in the opposite side.

H. Output Assembly (16-or 32 Channel)

The ATC Cabinet with 16 output channels shall be a 19 inch EIA rack mounted device and include one 16 Channel Output Assembly. The Output Assembly shall house eight High-Density Switch Packs and shall provide forty eight load circuits. One Serial Interface Unit shall provide interface and control between the Output Assembly and the ATC. The Output Assembly shall house the Cabinet Monitor Unit, Main Contactor, Stop Time Switch, Flash / Auto Switch, four Circuit Breakers and Momentary 24 VDC Bypass Switch.

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The ATC Cabinet with 32 output channels shall be a 19 inch EIA rack mounted device and include one 32 Channel Output Assembly. The Output Assembly shall house sixteen High-Density Switch Packs and shall provide ninety six load circuits. Two Serial Interface Units shall provide interface and control between the Output Assembly and the ATC. The Output Assembly shall house the Cabinet Monitor Unit , the Main Contactor, Stop Time Switch, Flash / Auto Switch, eight Circuit Breakers and Momentary 24 VDC Bypass Switch.

I. Field Output Termination Assembly

The 16-Channel Field Output Termination Assembly (FOTA) shall be interconnected with the Output Assembly and house eight High-Density Flash Transfer Relays (HDFTR) and 16 Flash Program Blocks (FPB). The HDFTRs and FPBs shall be provided to control and select the color (red, yellow, or dark) during ATC Cabinet flash mode. Pluggable and replaceable transient protectors shall be provided at the field terminals for the protection of the High Density Switch Packs. A visual method shall be provided to indicate when the transient protector has failed. Label each HDFTR position with the number of its associated High Density Switch Pack (1-16). Label each FPB position with the number of its associated channel (1-16). Provide a FOTA with sixteen 6-position factory molded terminal blocks. Label each terminal block receptacle with the number of its associated channel (1-16). Provide additional labels to clearly indicate which terminals correspond to the red, yellow, and green switch pack outputs. Match the color of these labels to the color of their associated output (red, yellow, or green).

Provide one Field Output Termination Assembly with a 16-Channel Output Assembly.

Provide two Field Output Termination Assemblies with a 32-Channel Output Assembly.

Mount the 16-Channel Field Output Termination Assembly across the 19 inch EIA rack directly behind the Output Assembly. Ensure the 16-Channel Field Output Termination Assembly swings down to provide access to the HDSP Suppressors.

5. ATC Cabinet Components

A. Cabinet Monitor Unit

Provide a Cabinet Monitor Unit (CMUip) for cabinet monitoring, to query various cabinet conditions, and, if the application requires action, transfer control from the ATC to a flashing control mode. The CMUip shall be developed specifically for the ATC Cabinet, pluggable, interconnect with the Output Assembly, and include communication circuitry to interface SB1 and SB3. The CMUip shall include a microprocessor, memory devices including non-volatile memory, and front panel indicators. The CMUip shall have the capability to fully monitor 32 output channels and utilize direct SB3 communication to each High Density Switch Pack – Flasher Unit for field voltage and load current status. The CMUip shall be programmed with an interchangeable Datakey and include an Ethernet port for diagnostics and remote management. The CMUip shall include a built-in diagnostic wizard that: analyzes the ATC controller output commands and High Density Switch Pack – Flasher Unit field input status; isolates whether the cabinet fault was caused by an ATC malfunction, failure in the load bay, or field wiring; identifies the faulty channels and output directly; and provides guidance on how the technician should isolate the cause of the malfunction.

The High Voltage (HV) rated CMUip shall be provided for 120 VAC operation.

The Low Voltage (LV) rated CMUip shall be provided for 48 VDC operation.

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B. MonitorKey Programming Tool

Provide a Programming Tool with the capability to Read and Write data from the CMUip Datakey device. Ensure the MonitorKey software is compatible with the CMUip.

C. Cabinet Monitor Unit – Auxiliary Display Unit

Provide a Cabinet Monitor Unit – Auxiliary Display Unit (ADU) of the same manufacturer and type as the CMUip. The ADU shall be a 19 inch rack mounted device, utilize one rack space, and powered from the cabinet 48 VDC supply. All indicators shall be clear LEDs and shall not depend on reflectors or diffusion as part of the design. Clear LEDs shall not appear to be on when exposed to ambient light. The ADU shall provide 32 columns of LED indicators corresponding to channels 1 through 32. Each column shall be composed of a Red, Yellow, and Green status plus a Blue LED for fault status. The ADU will provide an enhanced user interface for the ATC Cabinet Monitor Unit system and provide the ability to view status, configuration settings, voltages, and event logs through an LCD menu driven display. The LCD display provides detailed status information from the CMUip and a built-in diagnostic program that provides a view of the signal states involved in a fault, pinpoints faulty signal inputs, and provide guidance on how the technician should isolate the cause of a malfunction.

D. High Density Switch Pack - Flasher Unit

Provide a compact, pluggable, modular PCB-based High Density Switch Pack – Flasher Unit (HDSP-FU). Ensure the HDSP-FU is compatible with ultra-low power (less than 2 watts) LED signal heads and has a current monitoring feature for each output of each channel. Use real-time standardized high speed SB3 communications to send a complete set of RMS voltage and load current measurements to the Cabinet Monitor Unit. Ensure the HDSP-FU is 4-1/2” high x 6-1/2” deep and equipped with a handle, reset push button switch, six RYG LED indicators, four flasher LED indicators, one power LED indicator and two Rx/Tx LED indicators. The HDSP-FU can function as either a switch pack (HDSP) or as a flasher unit (HDFU). Provide two RYG channels of operation (six outputs) in the HDFU when installed in the Output Assembly. Ensure when installed in the Service/Power Assembly, the HDFU functions as a four-output flasher.

The High Voltage (HV) rated HDSP-FU shall be provided for 120 VAC operation.

The Low Voltage (LV) rated HDSP-FU shall be provided for 48 VDC operation.

E. Serial Interface Unit

The Serial Interface Unit (SIU) functions as the cabinet communications and control unit. The SIU shall be a compact, pluggable, and modular PCB-based device with a half-width faceplate. The SIU shall use real-time standardized 614.4 Kbps communications with the ATC to transfer command and response data on SB1 and SB2. Each SIU shall be equipped with 54 programmable input/output pins, four optically isolated input pins, one line sync reference input pin and 4 address select input pins. The optically isolated inputs shall be either 120 VAC or 24 VDC. The SIU outputs shall be rated at 150 mA continuous sink current, a 500 mA typical current limit on each output, rated to 50 V, and utilize a voltage clamp for inductive transient protection. The SIU shall be equipped with a front panel LED indicator that can report the current SIU assembly address assignment for cabinet configuration verification. The SIU shall be equipped with a front panel serial port used to provide diagnostics using monitoring software.

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F. Flash Transfer Relays

The High Density Flash Transfer Relay (HDFTR) shall have a hermetically sealed cover to ensure it is moisture proof. Fill the HDFTR with dry nitrogen to protect contacts from corrosion and to prevent condensation. Provide a shock and impact resistant metal can cover with solid and bend proof pins on the HDFTR. The HDFTR shall be rated for 5 Amps at 120 VAC switching, 10 Amps surge. The coil Voltage shall be 48 VDC. The HDFTR shall have an LED indicator to display contact transfer position.

G. Cabinet Surge Protection Device

The Cabinet Surge Protection Device shall be modular, utilize a pluggable 12-position Beau 5412 connector, rated for 120 VAC, single phase, operation, and integrate as part of the Service Assembly. The Cabinet Surge Protection Device shall incorporate warning and failure indicators with a dry relay contact remote sensing circuit. Ensure the unit is rated at continuous service current of 15 Amp and maximum clamp voltage of 340 VAC. Filter noise and spike from 10 KHz to 25 MHz with a peak surge current of 45.5 kA/total.

H. High Density Switch Pack Transient Protector

The High Density Switch Pack Transient Protector shall be designed specifically for traffic controller cabinet operation, modular, and pluggable. Provide the unit epoxy encapsulated and equipped with 9-position 5.08 mm factory molded connector. The unit shall protect up to six circuits. The High Density Switch Pack Transient Protector shall have an operating voltage of 120 VAC, clamping voltage of 340 VAC, and peak surge current of 39 kA. Ensure the unit dimensions are 2" high x 0.7" wide x 2" long.

I. Detection Module Suppressor

Ensure the Detection Module Suppressor is modular and pluggable. Provide the unit epoxy encapsulated and equipped with 6-position 5.08 mm factory molded connector. The unit shall provide differential and common mode protection for up to six circuits. Provide device operating voltage of 75 VDC and clamping voltage of 130 VDC. Ensure the unit dimensions are 2" high x 0.7" wide x 1.2" long.

J. Main Contactor

The Main Contactor (MC) shall be mercury free, rated at 120 VAC at 60 Amps. The MC coil shall be rated at 48 VDC, and shall be equipped with an input indicator and Single Pole Single Throw—Normally Open (SPST – N.O.) contacts.

K. Shelf - Type I

Provide a shelf that mounts across all four 19 inch EIA rack and provides a surface that extends from the front to the back rails. The shelf shall be of the same material as the cage rails and have a minimum weight capacity of 200 lbs. to support up to two backup power system batteries. The shelf shall be vented to allow heat to pass through the shelf surface.

L. Shelf - Type II

Provide a cantilever shelf that mounts across a 19 inch EIA rack and is mounted behind the Auxiliary Communication Panel. The Shelf - Type II shall provide a minimum surface area of 38 in². The shelf shall be of the same material as the cage rails and have a minimum weight capacity of 200 lbs. to support up to two backup power system batteries. The shelf shall be vented to allow heat to pass through the shelf surface.

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M. AC Power Distribution Unit

The AC Power Distribution Unit shall be a 19 inch EIA rack mounted device and installed in Segment B for the purpose of supplying clean AC power to communications equipment. The AC Power Distribution Unit shall interface with the Service Assembly, clean power receptacle mounted in Segment A. The Unit shall include a minimum of seven single NEMA 5-15 receptacles and include a resettable load protection device.

N. Auxiliary Communications Panel

(1) Auxiliary Communications Panel

The Auxiliary Communications Panel shall be used to mount lease line communication hardware on a vertical plywood back board installed behind the fifth door of the cabinet. The plywood backboard will be mounted to a solid metal panel structure that attaches to the EIA rails and is set back 8 inches into the rack cage.

The panel shall be made up of rack mount angles (ears), solid side walls, and the metal back plate. The panel shall be fabricated from one piece of metal and shall be the same material as the cabinet. The panel shall be mounted across the two front EIA rails with a minimum of four rail attachment points per side.

(2) Panel Dimensions

The panel dimensions shall be 19 inches wide end to end with a minimum opening of 17 inches inside the rails, 20 inches tall, and fabricated to provide 8 inches of depth into the rack cage.

(3) Panel Board and Power Receptacles

Mount a 3/4 inch plywood backboard across the back panel. The panel board shall be centered on the panel, be 20 inches tall and have a minimum of a 1/2 inch gap between the backboard and the panel side walls. One 15 amp double duplex GCFI receptacle shall be installed, mounted to the comm. panel and passing through the panel board, 4 inches from the right and 6 inches from bottom of the panel. Install a 60" SJOOW rubber cord 15 Amp male cord cap inside the cabinet connected to raw AC power.

6. Cabinet Base Adapter

The Base Adapter shall be fabricated of the same material and finish as the cabinet housing.

A. Base Adapter Dimensions

The base adapter shall be a minimum of 12 inches high by 44 1/2 inches wide by 26 inches deep ($\pm 1/2$ inch). The top and bottom of the base adapter shall have an opening that matches the opening of the cabinet housing, 36 inches wide by 20 inches long ($\pm 1/2$ inch).

B. Hardware

Four bolt sets shall be supplied with each Base Adapter. A bolt set shall consist of one bolt, two flat washers, and one nut. The bolt shall be stainless steel, 3/4 inch in diameter, and shall be 1 1/2 inches long. Flat washers and nut shall be made of the same material as the bolt.

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C. Anchor Bolt Holes

Around the top cutout shall be four punched holes that match the anchor bolt holes of the ITS Housing #3 type cabinet. Provide bolts, nuts, washers, and lock washers to bolt the cabinet to the base adapter through these holes. Around the bottom cut out shall be four punched holes that also match the anchor bolt holes of the ITS Housing #3 type cabinet.

D. Structural Requirements

Construct the base adapter so that it does not sag under the weight of the fully loaded cabinet. Any internal members must not obstruct cables going from Segment A to Segment B of the cabinet, nor to the conduits below. All seams shall be continuously welded and ground smooth.

7. Documentation

Provide one electronic version (PDF format) and two prints of the controller circuit diagram. The prints shall be produced from the original drawing and shall be clear and legible. Place both hard copies of the circuit diagram inside the sliding drawer in a readily accessible waterproof enclosure.

8. Integration and Testing

Integration and Testing shall be conducted in accordance with Section 703.03(j) of the Specifications.

9. Warranty

Traffic signal equipment cabinets and all cabinet components shall be warranted to be free of defects in material and workmanship for three years from date of acceptance by the Department. The manufacturer's warranty shall be provided in writing with each traffic signal equipment cabinet. The warranty shall state that the manufacturer will repair with new materials or replace at no charge any product containing a warranty defect during the warranty period, and all materials returned for warranty repairs will be made through the manufacturer or product distributor at no added charge to the Department.

III. CONFIGURATIONS

1. ATC Cabinet Configuration

The ATC Cabinet shall be loaded with the following components:

A. Cabinet Monitor Unit

- One Cabinet Monitor Unit (HV) for High Voltage Cabinets
- One Cabinet Monitor Unit (LV) for Low Voltage Cabinets

B. Service Assembly/Power Assembly:

- One Cabinet Surge Protection Device
- One High Density Flasher Unit (HV) for High Voltage Cabinets
- One High Density Flasher Unit (LV) for Low Voltage Cabinets

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C. Input Assembly - 24-Channel (Two Units):

- Two Serial Interface Units
- Three DC Isolators
- Two AC Isolators
- Two Opto Input Cards

D. Field Input Termination Assembly - 24-Channel (Two Units):

- Twelve Detection Module Suppressors

E. Output Assembly (16-Channel):

- One Serial Interface Unit
- Eight High Density Switch Pack (HV) for High Voltage Cabinets
- One Cabinet Monitor Unit (HV) for High Voltage Cabinets
- Eight High Density Switch Pack (LV) for Low Voltage Cabinets
- One Cabinet Monitor Unit (LV) for Low Voltage Cabinets

F. Output Assembly (32-Channel):

- Two Serial Interface Units
- Sixteen High Density Switch Packs (HV) for High Voltage Cabinets
- One Cabinet Monitor Unit (HV) for High Voltage Cabinets
- Sixteen High Density Switch Packs (LV) for Low Voltage Cabinets
- One Cabinet Monitor Unit (LV) for Low Voltage Cabinets

G. Field Output Termination Assembly (16-Channel):

- Eight High Density Flash Transfer Relays
- Eight High Density Switch Pack Transient Protectors
- Sixteen Red Flash Program Blocks
- Four Yellow Flash Program Blocks
- Four White Flash Program Blocks

H. Field Output Termination Assembly (32-Channel):

- Sixteen High Density Flash Transfer Relays
- Sixteen High Density Switch Pack Transient Protectors
- Thirty-two Red Flash Program Blocks
- Eight Yellow Flash Program Blocks
- Eight White Flash Program Blocks

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IV. PROCEDURES

1. Installing Ground-Mounted ATC Traffic Signal Cabinets

Ground mounted traffic signal equipment cabinets shall be installed on a concrete foundation in conformance with Section 700 of the Specifications and the Standard Drawings. Foundations will be measured and paid for separately.

2. Installing the Base Adapter

Prior to bolting the base Adapter to the foundation, apply silicone sealant to the mating surface of the adapter to prevent water from seeping between the adapter and foundation. Likewise, prior to bolting the cabinet to the base adapter, apply silicone sealant to the mating surface of the cabinet to prevent water entry. Ensure that the cabinet is plumb, using shims if necessary, and ensure that it is properly aligned with the front edge of the base adapter.

V. MEASUREMENT AND PAYMENT

ATC Cabinet— 5-Door Configuration will be measured in units of each and will be paid for at the Contract each price. This price shall include furnishing, installing, and testing of all equipment and materials, and for all tools, labor hardware, supplies, support, personnel training, shop drawings, documentation, and incidentals necessary to complete the work.

Payment will be made under:

Pay Item	Pay Unit
ATC Cabinet— 5-Door Configuration (<i>No. of Outputs, HV or LV</i>)	Each

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VIRGINIA DEPARTMENT OF TRANSPORTATION
SUPPLEMENTAL SPECIFICATION FOR
SECTION 703 TRAFFIC SIGNALS
(ADVANCED TRANSPORTATION CONTROLLER HARDWARE AND FIRMWARE)

March 13, 2018
0003-036-610, C501

SECTION 703 TRAFFIC SIGNALS is amended as follows:

Section 703.02(a). Traffic Signal Controllers is replaced with the following:

The Advanced Transportation Controller (ATC) shall be provided by the following Virginia Information Technology Agency (VITA) approved vendor:

McCain, Inc.

The Contractor shall provide the controller model 2070LX.

The ATC shall be provided as a complete functioning unit with the following modules:

CPU Module (2070-1C)
I/O Module (2070-2B)
Front Panel Display (2070-3B)
Power Supply (2070-4A)
Chassis

VITA approved ATC firmware shall be provided with each controller by the following VITA approved vendor:

Advanced Traffic Solutions, LLC

For existing traffic signals, the Contractor shall have the VITA approved vendor convert the existing timing database into a format usable by the ATC firmware.

The Contractor shall install the ATC in the ATC Cabinet – Combination Configuration, the ATC Cabinet – 5 Door Configuration, or existing traffic signal controller cabinet as specified in the contract documents.

Section 703.03(h). Installing Uninterruptible Power Supply is amended to replace the first sentence of the first paragraph with the following:

The UPS system shall be installed in either the ATC Cabinet – Combination Configuration or ATC Cabinet – 5 Door Configuration in accordance with the manufacturer's instructions.

Section 703.04 – Measurement and Payment is amended to replace the eighth paragraph with the following:

Local controller will be measured in units of each for the type specified and will be paid for at the contract unit price per each. This price shall include conversion of the existing timing database, timing implementation, firmware, modules, manufacturer's instructions, relays, auxiliary equipment, conductor cables, grounding systems, wiring, fittings, testing, and warranty.

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VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
ACCESSIBLE PEDESTRIAN SIGNAL EQUIPMENT

April 27, 2018
0003-036-610, C501

I. DESCRIPTION

This work shall consist of furnishing and installing accessible pedestrian signal (APS) equipment in accordance with this special provision and as shown on the plans or as directed by the Engineer. APS equipment shall meet all of the requirements of the latest Federal MUTCD for the type shown on the plans; with the exception that no "cuckoo", "chirp" or any other avian sounds will be allowed. The APS equipment shall be a pushbutton integrated unit with a raised (tactile) arrow that vibrates when the "WALK" indication is on. APS shall have a locator tone, pedestrian activation tone, pedestrian activation LED indicator, a walk interval tone and shall have the capability of providing voice messages, with all tones/messages emitted directly from the speaker integrated within the push button assembly. APS equipment shall completely interface with all NEMA TS-1, NEMA TS-2, 170 and 2070 traffic signal control equipment and conflict/malfunction monitoring equipment.

II. ELECTRICAL

The APS control equipment shall operate with systems providing 95 to 130 VAC, 60 Hz throughout an ambient temperature range of – 29 to + 160 degrees F. at 100 per cent humidity, non-condensing.

Push buttons, speakers and vibratory surfaces shall operate on low voltage DC with a maximum of voltage of 30 volts DC throughout an ambient temperature range of – 29 to + 160 degrees F. at 100 per cent humidity, non-condensing. APS equipment shall contain over current protection either by fuse or circuit breaker and shall provide transient voltage surge protection.

III. AUDIBLE INDICATIONS

1. **Locator tones** shall be a percussive tone similar to the walk interval tone except that it shall be a slower rate. The tone shall have duration of 0.15 seconds or less and shall repeat at 1 second intervals.

Locator tones shall consist of multiple frequencies with a dominant component at 880 Hz.

The volume of the locator tone measured at 36 inches (915 mm) from the pedestrian signal device shall be 2 dB minimum and 5 dB maximum above ambient noise level with a maximum of 100 dB and shall be responsive to ambient noise levels.

Locator tones shall be audible 6 to 12 feet (1.8 to 3.7 meters) from the pushbutton or to the building line, whichever is less.

2. **Pedestrian activation tone** shall be a beep, tick or other percussive tone and begin immediately following the initial button press to confirm that pedestrian signal timing has been activated.

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3. **Walk interval tone** shall be a percussive tone similar to the locator tone except repeat at a faster rate. The duration of the tone shall repeat 8 to 10 times per second. The walk interval tone shall be emitted for as long as the visual walk indication is shown.

Walk interval tones shall consist of multiple frequencies with a dominant component of 880 Hz.

The volume of the walk interval tone measured at 36 inches (915 mm) from the pedestrian signal device shall be 2dB minimum and 5 dB maximum above ambient noise level with a maximum of 100 dB and shall be responsive to ambient noise levels.

4. **Walk interval message** shall be optional in lieu of the walk interval tone as indicated on the plans, or in situations where two or more pushbuttons are located within 10 feet of each other. All APS equipment shall emit a walk interval speech message for as long as the visual walk indication is shown, or for 7 seconds in the case of a pedestrian signal that rests in walk. The speech message shall be programmed to be in the format “[designated street name]”, “walk sign is on to cross”, “[designated street name]”, with the appropriate street names programmed into the message, unless directed otherwise by the Engineer. Suffixes such as “Street” or “Avenue” shall not be used unless this information is necessary to avoid ambiguity at a particular location. If the intersection has an exclusive pedestrian phase then the speech message shall be programmed to say “Walk sign is on for all crossings”. All APS equipment shall have the capability of emitting a walk interval speech message for as long as the visual walk indication is shown. The speech message shall be as indicated on the plans.

The walk interval speech message volume measured at 36 inches (915 mm) shall be 2 dB minimum and 5 dB maximum above ambient noise level with a maximum of 100 dB and shall be responsive to ambient noise levels.

5. **Push button informational message** shall be optional as indicated on the plans. All APS equipment shall have the capability of emitting an informational speech message. The message shall be activated immediately upon engaging the push button or upon pushing and holding the push button up to but not more than 0.5 seconds. Once activated, the information message shall repeat itself until being immediately truncated by the initiation of the walk interval tone or message. Pedestrian activation message shall be as indicated on the plans and programmed to be in the format “Wait to Cross”, “[designated street name]”, “at”, “[cross street name]”. The contractor shall program the appropriate street names into the message, unless directed otherwise by the Engineer. Suffixes such as “Street” or “Avenue” shall not be used unless this information is necessary to avoid ambiguity at a particular location.

The informational speech message volume measured at 36 inches (915 mm) shall be 2 dB minimum and 5 dB maximum above ambient noise level with a maximum of 100 dB and shall be responsive to ambient noise levels.

IV. VIBRATING TACTILE ARROW

APS shall have a vibrating, tactile (raised) arrow installed to point parallel with the direction of travel on the crosswalk. The arrow shall vibrate only during the walk interval. The arrow can be part of the pushbutton or located on top of the pushbutton housing.

The arrow shall be raised at least 1/32 inches (0.8 mm) and shall be at least 1 ½ inches (38 mm) in length. The arrow head shall be open at 45 degrees to the shaft and should be 33 percent the length of the shaft. Stroke width shall be 10 to 15 percent of the length of the arrow and shall contrast with the background.

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V. BEACONING

APS equipment shall be capable of providing beaconing. APS systems shall have provisions for the use of additional speakers.

VI. ACCESSIBLE PEDESTRIAN PUSH BUTTONS

Pedestrian push buttons shall be electronic operation and a minimum of 2 inches and a maximum of 4 inches in diameter. The Department will not allow the use of push button mechanical contact closure devices for the push button operation. The force required to activate the push button shall be no greater than 2.5 pounds. Push buttons shall comply with the Americans with Disabilities Act and the MUTCD.

Pedestrian push buttons, housings, and assemblies shall be weather-tight and tamperproof. Pedestrian push buttons, housings, and assemblies shall be designed to prevent electrical shock in all types of weather and shall have provisions for grounding. Push buttons shall have electrical spade connections on the switch. Wire and wire-nut connections will not be acceptable.

Push button switch assemblies shall have a minimum life of 10 million actuations and shall operate on low voltage (not more than 15 volts AC or 24 volts DC). Switch and assemblies shall be certified or approved by UL or CSSA.

VII. SIGNS

Pedestrian crossing signs shall be installed at each location in accordance with the MUTCD. Signs or other information shall also be provided in an accessible format, such as Braille, raised letters, raised arrows or raised diagrammatic maps as shown on the plans.

VIII. PROCEDURES

APS devices shall be installed in accordance with the MUTCD and as indicated on the plans or as directed by the Engineer. APS control units shall be installed inside of the traffic signal control cabinet as shown on the plans.

All APS recorded messages, signs, and accessible formatted information shall be submitted to the Engineer prior to installation for approval.

The Contractor shall demonstrate the features and functions in the presence of the Engineer for approval.

IX.

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WARRANTY

All accessible pedestrian signal (APS) equipment shall carry a manufacturer's warranty against defective material and workmanship of no less than three years. Warranty periods for the APS equipment shall begin on the date of final acceptance by the Department.

X. MEASUREMENT AND PAYMENT

APS Pedestrian actuation will be measured in units of each for the standard specified and will be paid for at the contract unit price per each. This price shall include accessible pedestrian pushbutton with integrated speakers, vibrating arrows, wiring, fittings, signs, accessible information (Braille, raised letters or raised diagrammatic maps), testing, adjustment and alignment, and warranty; mounting hardware, and when required, pole, caps, breakaway support systems, handhole and cover, conduit, condulet, supplementary grounding electrode, grounding conductor, and concrete foundation.

Payment will be made under:

Pay Item	Pay Unit
APS Pedestrian actuation (Standard)	Each

ORDER NO.: C53
CONTRACT ID. NO.: C0000109471C01

VIRGINIA DEPARTMENT OF TRANSPORTATION
SPECIAL PROVISION FOR
CELLULAR ROUTER

April 2, 2020
0003-036-610, C501

I. DESCRIPTION

This work shall consist of furnishing, installing, and fully integrating cellular router equipment in accordance with this Special Provision, the Plans, or as directed by the Engineer. Cellular router equipment shall be used for bi-directional data communications between ITS traffic field devices and the Region's Traffic Operations Center (TOC).

II. MATERIALS

Equipment shall conform to the National Electrical Code (NEC), the National Electrical Safety Code (NEC), Underwriter's Laboratories (UL), and all local safety codes in effect on the date of the contract advertisement.

III. EQUIPMENT

The cellular router shall be Restriction of Hazardous Substance directive (ROHS) compliant and FCC approved. The cellular router shall be certified by the PCS Type Certification Review Board (PTCRB). The cellular router shall support at a minimum the following host interfaces: four Ethernet 10/100 Mbps RJ-45, two serial ports (at least one DB-9 port and one RJ-45 asynchronous serial ports), one USB 2.0 (Mini-B5), two built-in SIM trays, and 2 SMA ports for dual cellular/LTE antenna operation. The cellular router shall also support the following antenna connections: Primary 50 Ohm SMA, and Rx Diversity: 50 Ohm SMA. Cellular routers shall be Digi WR44-L5A3-CE1-RD or approved equal.

10. Electrical Specifications

The cellular router shall operate on North American AC 120 volt, 60 Hertz, have an AC adapter, and support a locking power connector. The cellular router shall operate at both standard 12 and 24 VDC power systems, and shall function without impairment from a sustained DC supply of 9 to 36 Volts DC.

11. Environmental Specifications

Cellular router equipment shall be hardened for field cabinet conditions. Cellular router shall have a minimum operating temperature range of -40°F to 167°F with a maximum non-condensing relative humidity as defined in the environmental requirements section of the NEMA TS 2 standard. The unit shall use passive cooling of the enclosure with no requirement for internal fans.

12. Physical Specifications

The unit shall be DIN-rail or shelf mountable. The enclosure shall be suitable for mounting in confined spaces and of rugged design and constructed of metal on all sides to protect all electronic components. The height of the enclosure shall permit mounting on an existing equipment tray with limited vertical clearance. All electronics that comprise the router (including cellular data modems, etc.) shall be fully contained within the enclosure.

13. Network and Routing Specifications

The cellular router shall support the following:

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PROTOCOLS:

HTTP, HTTPS, FTP, SFTP, SSL, SMTP, SNMP (v1/v2c/v3), SSH, Telnet and CLI for web management; SMS management, protocol analyzer, ability to capture PCAP for use with Wireshark; DynDNS; Dynamic DNS client compatible with BIND9/No-IP/DynDNS

SECURITY/VPN:

Stateful inspection firewall with scripting, address and port translation; VPN: IPsec with IKEv1, IKEv2, NAT Traversal; SSL, SSLv2, FIPS 197, Open VPN client and server; PPTP, L2TP; Concurrent VPN Tunnels Minimum five (5).

Cryptology:

SHA-1, MD5, RSA.

Encryption:

DES, 3DES and AES up to 256-bit.

Authentication:

RADIUS, TACACS+, SCEP for X.509 certificates; Content Filtering (via 3rd party) ; MAC Address Filtering; VLAN support; Ethernet Port Isolation.

ROUTING/FAILOVER:

IP pass-through ; NAT, NAT with IP Port Forwarding; Ethernet Bridging; GRE; Multicast Routing.

Routing Protocols:

PPP, PPPoE, RIP (v1, v2) OSPF, SRI, BGP, iGMP routing (multicast); RSTP (Rapid Spanning Tree Protocol).

IP Failover:

VRRP, VRRP+TM; Automatic failover/failback to second GSM network/Standby APN OTHER PROTOCOLS DHCP; Dynamic DNS client compatible with BIND9/No-IP/DynDNS; QoS via TOS/DSCP/WRED.

The VPN function must not require the installation of any special VPN client software on LAN-connected computing devices served by the gateway. The router shall be configurable as an SNTP server to distribute network time to its LAN connected clients.

14. Cellular Communications Specifications

The cellular interface shall support LTE Bands 2, 4, 5, 13, 17 and 25 in a single cell module, and automatically fall back to 3G and 2G technology when LTE is not available. The router shall be certified on Verizon and AT&T networks and shall support automatic failover to a secondary carrier when dual SIM cards are used.

15. Certifications and Security

The router shall comply with the following:

- FCC Part 15B certification
- UL 60950 safety certification
- CISPR 22, EN55024 and EN55022 for emissions/ immunity
- EN 300 019-2-5 for vehicular vibration & shock
- ISO7637-2 for compatibility with conducted transients

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The router shall support SSL v1-3, MAC address filtering, and Simple Certificate Enrollment Protocol (SCEP). A rules-based stateful firewall shall restrict the type of traffic that the router can transmit or receive on any interface based on a combination of IP address, service type, protocol type, port number and IP flags. Local and remote access to the administrative interface of the router shall be secured by password-protected login.

16. Management Capability

The Router shall have capability to allow centralized management of gateways, ease of integration via APIs, elastic scalability, commercial-grade reliability and industry-leading security policies. Every router shall be accessible remotely, and its status and configuration viewed and updated through a graphical user interface (GUI) through an individual connection. The management system shall be capable of automatically upgrading software at individual routers, a group of routers, or all routers, as specified by the system administrator.

17. Antenna Connections:

The antenna connectors shall be brass with a gold plated brass contact. Connectors shall meet MIL-Std. 202 and include weatherproofing materials to prevent moisture from entering the cabinet. RF antenna connectors shall be threaded or have a locking mechanism to prevent accidental removal of associated cables. Coaxial jumper cables shall have appropriate male end connectors to mate properly between the N-Female bulkhead connector and SMA-Female router connection points.

18. External Antennae

Two ruggedized LTE antennae compatible with the cellular router shall be provided for external mounting to the associated ITS controller cabinet or pole. Antennae shall meet the following specifications:

12. Color: Black
13. Material: UV resistant ABS plastic
14. Mount Style: ¾" NMO
15. Operating Temperature -40°C to 85°C
16. Gain: 0-4 dBi
17. Minimum frequency range: 700-2700 MHz (4G LTE / 3G)
18. Maximum Power: 100 W
19. Impedance: 50 Ohms
20. Maximum Dimensions: 4" (H) x 2" (Dia)
21. Radiation Pattern: Omnidirectional
22. Cabinet Bulkhead Connector: NMO Thru-hole mounted bulkhead connector with Type N female connector on the interior of the cabinet, installed with a rubber O-ring to prevent moisture from entering the cabinet from the top of the cabinet.

IV. PROCEDURES

The Contractor shall install all equipment according to the latest version of the manufacturer's installation procedures and industry accepted installation standards, codes, and practices, or as directed by the Engineer. All materials and installation practices shall be in accordance with the applicable OSHA requirements as found in 29 Code of Federal Regulations (CFR) Part 1926, Safety and Health Standards for Construction.

The Contractor shall be responsible for supplying and properly installing the field router and making all field connections according to manufacturer's recommendations.

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Integration: Prior to integration with the Department's existing system, the Contractor shall conduct field-based tests as well as remote tests from the TOC to verify proper operation of all new equipment. These tests shall be conducted with Contractor-provided computers, hardware, and software. The Contractor shall notify the Department in writing when new equipment is ready for integration. Any Contractor-provided computers will be disconnected at that time and retained by the Contractor.

The Contractor shall submit all necessary equipment documentation and demonstrate an ability to integrate the new equipment with the TOC's existing systems. If the TOC concurs with the equipment and configuration, the Contractor shall work with the TOC Systems Integrator to integrate the new equipment. The Contractor shall work with the TOC Integrator to resolve any integration issues. Contractor assistance shall include, but is not limited to, protocol description, vendor support, hardware interface documentation, configuration support, device or system testing and verification, and loaner equipment for the integration test bed. The Contractor shall be responsible for all costs associated with this integration.

The Contractor shall troubleshoot the system and pinpoint integration problems involving Contractor-supplied equipment. The Contractor shall remedy any deficiency discovered during integration attributable to Contractor-supplied equipment or software, Contractor negligence, poor workmanship, or other fault that violates requirements set forth in the contract documents or drawings. The Contractor shall not be responsible for modifying or debugging any Department-supplied hardware or software.

Communications System Operational Testing: The Contractor shall submit a written test plan for approval by the TOC at least 2 weeks prior to the start of a mutually agreed upon test window.

Warranty: Provide a minimum 5 year warranty with each router installation on all equipment to ensure that all products are free of manufacturing, design, material, and workmanship defects. The warranty period shall begin on the date of final acceptance of the work as defined in Section 108.09 of the Specifications.

V. MEASUREMENT AND PAYMENT

Wireless cellular router will be measured in units of each and will be paid for at the Contract each price. This price shall include furnishing and installing the cellular router, antennae, fittings, and miscellaneous cabling; installing and testing operational software and firmware; furnishing supplies, technical support, personnel training, shop drawings, and documentation; and coordinating leased services required to complete the work. Seventy percent of the Contract price will be paid upon delivery of materials, software protocols, and documentation; installation of the cellular router and all wiring for a fully operational cellular router; and successful completion of the field acceptance tests. Thirty percent of the Contract price will be paid upon successful integration with the VDOT Traffic Operations Center and successful completion of the subsequent Communications and System Operational Test.

Payment will be made under:

Pay Item	Pay Unit
Wireless cellular router	Each