TECHNICAL SPECIAL PROVISION

FOR

EMERGENCY GENERATOR - PERMANENT AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T639A
EMERGENCY GENERATOR - PERMANENT AT RTC TOLL SITES

T639A-1 Description.

Furnish and install packaged emergency generator set(s) as shown on the Toll Facilities Plans.

T639A-2 Materials.

T639A-2.1 Standards:

Emergency backup emergency generator set(s) must meet the following applicable industry standards:

1. UL 489 Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.
2. NEMA MG1 Motors and Generators
3. NFPA 30 - Flammable and Combustible Liquids Code
4. NFPA 70 National Electrical Code
5. NFPA 110 - Emergency and Standby Power Systems

T639A-2.2 Qualifications:

The company selling the products specified herein must be an authorized distributor for the original equipment manufacturer. The distributor must be factory authorized to supply parts, perform field services, and perform factory warranty work on the emergency generator and associated products specified herein. The distributor must maintain a parts inventory for the equipment provided and stock 50% of all parts for the engine, generator, and automatic transfer switch at their service facility within 100 miles of the project job site. The company selling the products specified herein must operate a public parts counter or parts warehouse that is open to the public, 5 days per week, Monday through Friday. The Department may inspect the service facility to verify the parts stock.

T639A-2.3 Maintenance Parts:

Provide the following additional maintenance parts for each emergency generator:

1. One air filter
2. One oil filter
3. One fuel filter
4. One radiator fan belt

The parts will be new and must match the part numbers shown in the manufacturer's parts manual. Highlight these part numbers with a yellow highlighter in the paper parts manual. Parts that are not new OEM parts, or do not match the parts shown in the manufacturer's parts manual will be rejected.

T639A-2.4 Packaged Emergency Generator Set:

Acceptable original equipment manufacturers include:

1. Cummins Power
2. Caterpillar
3. Kohler
4. Approved equal

Classify the Emergency Power Supply System (EPSS) in accordance with NFPA 110 as Level 2, Type 10.

System Standby Rating: As shown on Plans for each toll facility, while operating inside a weather protective enclosure, and at an ambient temperature of 110 degrees Fahrenheit, and at an elevation of 100 feet above sea level. The emergency generator will use an engine mounted radiator with a pusher type radiator fan. The full standby rated output will be available with varying loads for the duration of the interruption of the normal source power. The average power output must not exceed 70% of the standby power rating. Typical operation is 200 hours per year, with maximum expected usage of 500 hours per year. The Standby power rating will be in accordance with ISO3046/1.

Generator (alternator) output voltage dip and frequency dip requirements: Upon application of 100% rated (full) load at 1.0 pf, in a single step, the instantaneous voltage dip at the output of the alternator shall not exceed 20% and the instantaneous frequency dip will not exceed 20%.

T639A-2.4.1. Engine: Provide a water cooled inline or V type, four stroke cycle, compression ignition diesel internal combustion engine with the following requirements:

1. Fuel: No. 2 fuel oil, ultra-low sulfur, not to exceed 15 ppm sulfur.
2. Engine speed: Rated for 1800 rpm.
3. Governor: Electronic isochronous governor. Random frequency variation shall not exceed ±0.25%.
4. Safety Devices: Pre-alarms and Engine shutdowns with alarms for high engine temperature, low oil pressure, overspeed, and emergency stop. Limits as selected by the manufacturer. Also provide overcrank / failure to start lock out and alarm.
5. Engine Starting: Positive engagement, cycle crank type, DC starting system with the number of starter motors in accordance with manufacturer's instructions. Include remote “two wire” starting controls.
6. Engine Jacket Coolant Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C) under all site conditions, and suitable for operation on 120 Volts or 240 Volts AC. Also provide isolation valves on the coolant supply and return hoses to facilitate maintenance on the heater.
7. Radiator: High ambient radiator using propylene glycol based coolant, with blower type fan, sized to maintain safe engine temperature in ambient temperature of 110 degrees F (43 degrees C) when the emergency generator is installed within the weather protective enclosure and running at 100% rated (full) load. Radiator air flow restriction 0.5 inches of water (1.25 Pa) maximum. Provide a metal radiator guard and provide an accessible coolant drain valve on the bottom of the radiator. If the weather protective enclosure makes the drain valve not accessible, then extend a permanent drain hose from the drain valve to the outside of the enclosure. The radiator shall also include low coolant alarm contacts.

T639A-2.4.2. Engine Accessories

Aftercooler, intake air filter(s) with differential pressure service indicators, spin on lube oil filters, lube oil cooler, gear driven water pump, battery charging alternator, and crank case fumes disposal tube(s) routed outside. Also provide an oil drain valve on the bottom of the engine oil pan. If the weather protective enclosure makes the drain valve not accessible, then extend a permanent drain hose from the drain valve to the outside of the enclosure.

1. Engine Fuel System: Primary spin on fuel filter(s) with separate fuel/water separator with metal housing and see-through containment bowl, fuel transfer pump with a suction head of 9 feet minimum, a hand operated fuel priming pump with an analog fuel pressure gauge mounted next to the hand prime pump. A factory installed fuel oil cooler shall be mounted on the radiator to keep the return fuel temperature below 85 degrees F.

2. Mounting: Provide unit with suitable spring type vibration isolators mounted under the structural steel base or steel tank. If the engine and the alternator are isolated from the structural steel base or tank by rubber snubbers/mounts, then vibration pads may be utilized under the structural steel base.

3. Paint. The engine and the engine accessories shall be painted by the original manufacturer. Additional painting of the engine and engine accessories are not acceptable to the Department. The engine may not be repainted to change the color. Belts and hoses shall not be painted. The OEM part numbers must remain visible on all belts, hoses, and filters.

T639A-2.4.3. Generator (Packaged Emergency Generator Set)

Provide a NEMA MG1, single phase, four pole rotor, synchronous generator with a brushless permanent magnet exciter with the following requirements:

1. Insulation Class: H.
2. Temperature Rise: 130 degrees C.
3. Enclosure: NEMA MG1, drip proof, IP 22 guarded.
4. Voltage Regulation: Include generator mounted volts per hertz exciter regulator to match engine and generator characteristics, with voltage regulation plus or minus 1 percent from no load to full load. Include manual controls to adjust voltage drop, voltage level (plus or minus 25 percent) and voltage gain.

The manual voltage adjustment will be used to adjust the output voltage up to 120% of nominal to test the over voltage protective device. The manual voltage adjustment will also be used to adjust the output voltage down to 80% of nominal to test the under voltage protective device.

T639A-2.4.4. Accessories (Packaged Set)

Provide the following accessories:

1. Exhaust Silencer: Critical type silencer, with muffler companion flanges and flexible stainless-steel exhaust fitting assembly, sized in accordance with engine manufacturer's instructions. Also provide an outlet elbow and a rain cap. If the exhaust piping penetrates the top of the outdoor enclosure, a rain collar shall be installed around the exhaust piping to minimize water entering the weatherproof enclosure.

2. Removable Insulation Blankets: If the exhaust silencer is mounted inside the weather protective enclosure then the silencer and stainless-steel flex will be covered with removable insulation blankets. The insulation blankets will be minimum one inch thick with three layers. The outer layer will be silicone impregnated fiberglass. The middle layer will be fiberglass. The innermost layer will be stainless steel mesh.

3. Batteries: Heavy duty, high output, diesel engine starting type, vibration resistant,

lead acid storage batteries. The advertised Cold Cranking Amps shall be at 0 ºF. Ensure the batteries will withstand extreme vibration and sample batteries have been tested in accordance with IEC 61056-1. The prototype batteries shall pass a 50-hour vibration resistance test. Match the battery voltage to the engine starting system. Include copper battery cables and a key operated battery disconnect switch. Submit data sheet to the engineer on the battery switch. Calculate the voltage drop in the battery cables with full load cranking amps. Provide this calculation with the shop drawing submittals.

4. Battery Tray: Treated for electrolyte resistance, constructed to contain spillage.

5. Battery Charger: The battery charger must be enclosed, automatic, dual-rate, solid-state, constant-voltage type having ac voltage compensation, dc voltage regulation, and must be current limiting. The battery charger must be located in the engine-generator set enclosure. The battery charger must employ transistor-controlled circuits to provide continuous taper charging. The battery charger must have two ranges, float and equalize, with a 0 to 24 hour equalizer timer, a dc cranking relay, silicon diode full-wave rectifiers, automatic surge suppressors, a DC ammeter, and a DC voltmeter. The battery charger must have a continuous rated output of not less than 10 amperes. The battery charger must conform to UL 1236.

6. Line Circuit Breaker: Manufactured in accordance with NEMA AB 1, and UL 489, molded case circuit breaker, generator mounted in a NEMA 1 enclosure. The circuit breaker enclosure shall provide adequate space for the Electrical Contractor to bend the generator feeder conductors in accordance with the NEC. The circuit breaker protective trip unit shall include integral thermal and instantaneous magnetic trips in each pole, sized in accordance with NFPA 70. Include a set of auxiliary contacts on the generator circuit breaker. The contacts will be open when the circuit breaker is open and closed when the circuit breaker is closed. These contacts will be monitored by the SCADA system.

7. Emergency Generator Control Panel: NEMA 1, IP22 generator mounted control panel made of heavy-duty sheet steel and vibration isolated from the emergency generator set. The control panel shall house the engine and generator controls, gauges and indicators. Also provide a hinged vandal door over the face of the control panel with provisions for a padlock. The control panel shall include the following equipment and features:

a. Frequency Meter: 45 - 65 Hz. Range.

b. AC Output Voltmeter with true RMS sensing, 1/2 percent accuracy with phase selector switch.

c. AC Output Ammeter with true RMS sensing, 1/2 percent accuracy with phase selector switch.

d. Output voltage adjustment.

e. Push to test indicator lamps, for low oil pressure, high water temperature, overspeed, and overcrank shutdowns.

f. Engine Off/Auto/Start/Stop selector switch.

g. Engine running time meter.

h. Oil pressure gauge.

i. Fuel pressure gauge.

j. Water temperature gauge.

k. Emergency stop button.

l. Auxiliary Relay: 3PDT, operates when engine runs, with contact terminals prewired to terminal strip.

m. Additional visual indicators and alarms as required by the Safety Indication and

Shutdown table below.

n. Remote Alarm Contacts: Pre-wire SPDT contacts to a terminal strip for remote alarm functions required by NFPA 110.

o. Provide over voltage protection (ANSI #59) and under voltage protection (ANSI #27) to protect the generator and/or building distribution system from a voltage regulator malfunction. Over voltage relay settings shall be adjustable from 100% to 125% of nominal voltage. Under voltage relay settings shall be adjustable from 75% to 100% of nominal voltage. The pickup and dropout times will be adjustable from 1 to 10 seconds. When the generator set is producing power, an over voltage or under voltage condition shall cause the emergency generator to automatically shut down on a fault. The engine shall not attempt to restart until the fault is acknowledged and the fault reset button is depressed. When the emergency generator shuts down normally and stops producing power, this shall not be considered a fault and the under-voltage relay shall not initiate an under-voltage fault.

p. The generator control panel shall include a factory installed Modbus RTU communication port that will be connected to the PLC within the SCADA system control panel.

q. The alarms indicated below will be transmitted to the SCADA system by the generator control panel Modbus RTU interface for use as Remote Audible (R.A.) alarms at Sunwatch.

Table 1- Safety Indication and Shutdowns

Indicator Function	Level 1				Level 2		
	C.V.	**S**	**R.A.**		**C.V.**	**S**	**R.A.**
Overcrank	x	x	x		x	x	x
Low water temp 70 degrees F	x		x		x		x
High engine temperature prealarm	x		x		o		x
High engine temperature	x	x	x		x	x	x
Low lube oil pressure prealarm	x		x		o		o
Low lube oil pressure shutdown	x	x	x		x	x	x
Overspeed	x	x	x		x	x	x
Low level radiator fluid	x		x		x		x
Low fuel level – main tank	x		x		x		x
Low fuel level – day tank	x		x		x		x
EPS supplying load	x		x		x		x
Generator control switch not in auto	x		x		x		x
High battery voltage	x		x		o		o
Low battery voltage	x		x		x		x
Battery charger AC failure	x		x		x		x
Remote emergency stop	x	x	x		x		x
Over Voltage		x				x	x
Under Voltage	x	x	x		x	x	x
Lamp / horn test switch	x		x		x		x
Audible alarm silencing switch	x		x		x		x
Generator breaker open	x		x		x		x
Emergency Power Off Initiated	x		x		x		x

CV; control panel visual indication. S: Shutdown of the EPSS. RA: Remote audible.
x = Required. o = Optional

T639A-2.4.5. Other Requirements (Packaged Emergency Generator Set): Additional requirements are as follows:

Weather Protective Generator Set Enclosure: Manufactured with 14-gauge aluminum prepainted panels with interlocking seams, stainless steel mechanical fasteners, stainless steel hinges, and door holder latches. The doors will be strategically located to allow access for maintenance and visibility of the instruments on the face of the control panel. The doors must have gaskets and must be key lockable. The engine radiator fan will draw air into the enclosure through a fixed aluminum intake louver and discharge the air through a gravity-open type aluminum discharge damper.

To prevent rodents and birds from entering the enclosure all openings in the enclosure will be covered from the inside with heavy aluminum wire mesh with 0.2 inch square holes. The wire diameter must be 0.047 inch or greater.

The emergency generator must operate properly inside the enclosure at rated (full) load with the outdoor ambient temperature up to 110 degrees Fahrenheit. The enclosure will be wind rated in "miles per hour" by the manufacturer in accordance with the Wind-Borne Debris Region map published in the current Florida Building Code.

Provide a factory installed sound attenuated aluminum enclosure. The enclosure shall be factory certified for the sound level not to exceed 72 db (A) when measured 7 meters from the emergency generator when the emergency generator is operating at 100% rated load.

T639A-2.4.6. Integrated Base Fuel Tank (Packaged Emergency Generator Set): Provide a sub-base tank as follows:

1. Provide a steel, dual wall, sub-base mounted fuel tank with a closed top primary tank, and a secondary containment basin.
2. Tank Capacity: The minimum fuel tank capacity must be designed for the emergency generator to run for 48 hours at design demand load, while providing power to the toll site(s) during a normal power outage.
3. The base fuel tank system shall be listed under UL 142, subsection entitled Special Purpose Tanks EFVT category, and will bear their mark of UL Approval according to their particular classification.
4. The fuel tank shall be a State of Florida Department of Environmental Protection (FDEP) approved tank with a current FDEP EQ number.
5. The above ground base fuel tank with secondary containment basin must be installed in accordance with the Flammable and Combustible Liquids Code—NFPA 30, the Standard for Installation and Use of Stationary Combustible Engine and Gas Turbines—NFPA 37, and Emergency and Standby Power Systems—NFPA 110.
6. The primary tank shall be rectangular in shape and constructed in clam shell fashion to ensure maximum structural integrity and allow the use of a full throat fillet weld.
7. The interior of the primary tank will be coated with a solvent-based film rust preventative coating.
8. Steel Channel Support System: Reinforced steel box channel for generator support, with a load rating not less than the weight of the packaged generator.
9. The fuel tank shall have a removable end channel for access to the electrical conduit stub up area.
10. Exterior Finish: The base tank exterior shall be painted black with two-part epoxy paint.

11. Normal venting shall be sized in accordance with the American Petroleum Institute Standard No 2000, Venting Atmospheric and Low Pressure Storage Tanks not less than 1-1/4" (3 cm.) nominal inside diameter.
12. The emergency vent opening shall be sized to accommodate the total capacity of both normal and emergency venting and shall be not less than that derived from NFPA 30, table 2-8, and based on the wetted surface area of the tank. The wetted area of the tank shall be calculated based on 100 percent of the primary tank. The vent is to be spring pressure operated: opening pressure is 0.5 psig and full opening pressure is 2.5 psig. The emergency relief vent shall be sized to accommodate the total venting capacity of both normal and emergency vents.
13. Provide a 2" NPT opening within the primary tank for the fuel fill port.
14. Ensure that the fuel tank is equipped with a fuel spill container designed to contain small spills that occur at the fill port. The spill container shall have a hinged cover that is lockable with a padlock, and a drain valve to allow draining spilled fuel in the container to the main fuel tank.
15. The fuel fill port shall be equipped with an overfill prevention valve assembly to prevent over filling the fuel tank by providing positive shut-off during the fuel delivery process. Set the fuel supply shut off at 95% of the primary tank capacity.
16. Provide a direct reading, UL listed, spiral, fuel level gauge with a hermetically sealed, vacuum tested dial, to eliminate fogging. Locate the direct reading fuel level gauge adjacent to the fuel fill port so that it is accessible to the fuel delivery person.
17. The main fuel tank shall be equipped with fuel level alarm float switches for high level, low level, and critical low level. Set the high fuel level alarm at 90% of the tank capacity, set the low fuel level alarm at 30% of the tank capacity, and set the critical low fuel level alarm at 15% of the tank capacity. The emergency generator shall automatically shut down if the critical low fuel level is activated. The fuel level alarms will be electrically connected to the generator control panel to provide for audible and visible alarms. The generator control panel shall transmit the fuel level alarms to the SCADA system by Modbus communications from the generator control panel.
18. To prevent overfilling the fuel tank. provide an intrinsically safe audible high fuel level alarm panel in the vicinity of the fuel fill port for local annunciation of a high fuel level condition. The alarm panel will sound a 90 decibel alarm at 4 feet away. Set the high fuel level alarm at 90% of the tank capacity. Include a means to silence the alarm, and a means to test the audible buzzer. Ensure the alarm panel enclosure is petroleum and weather resistant.
19. Fuel in the secondary containment basin float switch: A float switch will be installed into the containment basin of the fuel tank. The float switch will be electrically connected to the generator control panel. This switch will close a set of contacts if fuel leaks from the main tank and into the containment basin and a visible and audible alarm will be initiated on the generator control panel.
20. Provide a drain valve for the secondary containment basin.
21. Ball valve: A ball valve will be installed in the fuel supply line to the generator. The operator will be manually able to shutoff fuel to the generator supply line.
22. Decal: The fuel tank must be equipped with the following permanent signs:
    a. NFPA 704 “Fire Diamond”

b. “No Smoking: Flammable Diesel”
c. “XXX Gallons”

23. Install generator cabling and conduit connections to the Automatic Transfer Switch and the SCADA monitoring system as shown in the Plans and Specifications.

T639A-3 Delivery Storage and Handling.

Inspect the equipment for damages immediately upon delivery and contact the distributor or manufacturer before accepting a product that was damaged during shipping. Take photos of any damaged equipment before removing it from the truck. Make specific notes on the receiving ticket to describe the extent of any damage.

Protect equipment from dirt and moisture by securely wrapping in heavy plastic until it is installed.

When lifting the emergency generator with a crane, use spreader bars to prevent bending the weather protective enclosure

T639A-4 Shop Drawings and Submittals.

T639A-4.1 Shop Drawings:

Submit shop drawings in accordance with Standard Specifications Section 5 Acceptance Procedures for Toll Facilities, and the following:

1. Sizing Program Results. Provide printouts in the shop drawings from the emergency generator manufacturer’s sizing and simulation program. The sizing program printouts must show the following items or information:

2. Simulation #1. The program will show the selected emergency generator installed inside the weather protective enclosure while running at full (100% rated) load with the ambient temperature at 110 degrees Fahrenheit and the unit is installed at 100 feet above sea level. The printout will show the air flow in cubic feet per minute that is passing through the weather protective enclosure and the pressure drop across the selected radiator. Ensure the printout shows the selected engine model number, radiator model number or part number, alternator size, and weather protective enclosure part number. The printout will also show the instantaneous voltage and frequency dips upon a 100% rated load (block load) application at 0.8 power factor.

3. Simulation #2. Run a second simulation that lists the name and Watt rating of each electrical load that the emergency generator will serve. Use the construction plans to determine the site specific electrical loads and the sequence that the loads will be applied to the emergency generator. The printouts will show the voltage and frequency dips for each set of loads that are applied to the emergency generator. The power distribution system, including the backup generator, shall be designed to operate normally when the UPS units are operating at 100% full (rated) load.

4. Shop Drawings will include plan and elevation views with dimensions of the selected emergency generator with the exhaust system in place, and base fuel tank when applicable. Also show plan and elevation views with dimensions of the weather protective enclosure. Include specific dimensions for interconnection points such as:

a. Fuel piping connections

b. Exhaust outlet sizes and locations
c. Oil valve location
d. Radiator drain valve location
e. Spring isolator mounting points

5. Conduit stub up locations for the main generator feeder, jacket water heater circuit, and battery charger circuit.

6. Provide emergency generator fuel consumption rate curves at various loads.

7. Provide a manufacturer's emergency generator data sheet that shows the EPA Tier Rating of the emergency generator package. The emergency generator must meet or exceed the current EPA tier rating requirements for stationary and off-road diesel engines. The emergency generator model number shown on the EPA documentation must match the emergency generator model number being submitted for review.

8. Provide calculations that show the ventilation rate of the cooling air flowing through the weather protective enclosure. Also show the pressure drops across the louvers and across the engine radiator.

9. Provide a site specific, point to point interconnection diagram on 11" x 17" paper. The site specific drawing will show the exact connection points for the Modbus RTU communications cables, remote EPO station, battery charger alarms, main fuel tank alarms, engine start contacts in the automatic transfer switch, ATS auxiliary contacts to indicate the position of the ATS, engine running auxiliary contacts, etc. Submittals will not be reviewed without this site-specific diagram showing the name of the tolling site.

10. Provide an electronic copy of the operation and maintenance manuals.

T639A-5 Product Data.

Provide data sheets that show the dimensions, weights, ratings, interconnection points, features, ratings, and internal wiring diagrams if applicable, for the following items:

1. Engine
2. Alternator
3. Radiator and radiator fan size
4. Radiator drain valve and extension hose
5. Antifreeze
6. Engine oil
7. Engine crankcase fumes disposal tube
8. Fuel filter
9. Diesel Fuel Additives for increasing Cetane # and fuel stabilizer.
10. Water separator
11. Fuel prime pump – hand operated
12. Analog fuel pressure gauge
13. Fuel pump suction pressure data and maximum external restriction data
14. Head loss calculations for the proposed fuel piping and accessories
15. Flexible fuel lines

16. Jacket coolant heater and hose isolation valves
17. Oil drain valve and extension hose
18. Air cleaner and differential pressure indicator
19. Emergency Generator Control Panel
20. Modbus RTU communication card with wiring diagrams and a Modbus register map for the emergency generator controller
21. Main Circuit Breaker and trip unit
22. Engine cranking battery
23. Battery cable size and lengths. Show the cable Voltage Drop during engine cranking.
24. Battery rack
25. Battery charger
26. Exhaust silencer, elbow, and rain cap
27. Exhaust system stainless steel flexible connector
28. Thermal blankets for silencer
29. Vibration isolators
30. Weather protective enclosure
31. Base fuel tank, if applicable
32. Warranty statement
33. The distributor will provide a written statement concerning the availability of repair parts and the physical address of the parts counter or parts warehouse that is open to the public, 5 days per week, Monday through Friday.

Provide Operation Manual and Installation Manual as follows:

1. Provide one paper book copy and one electronic copy of the Manufacturer's Operation Manual and the Installation Manual for the emergency generator and automatic transfer switch at each Toll Building. Provide a set of manuals for each emergency generator provided under this contract. Deliver the manuals to the Engineer at the same time the manuals are electronically submitted.

2. If the manuals are incomplete, or are lacking in meaningful operational or installation instructions, or do not cover the model or type of equipment being provided, then the Department may REJECT the manuals and indicate on the shop drawing review forms the nature of the deficiencies. The contractor will then collect the deficient materials from the Engineer, correct the deficiencies, and then re-submit the materials for another review.

3. If the manuals are incomplete, or are lacking in meaningful operational or installation instructions, or do not cover the model or type of equipment being provided, the submission will be rejected.

T639A-6 Documentation.

Provide service and repair manual and the parts manual for each generator as follows:

1. Provide one digital copy and one paper book copy of the emergency generator manufacturer’s parts manual for each emergency generator provided under this contract. The

parts manual must show the original equipment manufacturers part numbers for all parts and accessories on the engine, radiator, main alternator, starter, charging alternator, and generator control panel.

2. Provide one digital copy and one paper book copy of the emergency generator manufacturer's service and repair manual and include the following.

3. Include the manufacturer's suggested preventive maintenance service activities, suggested intervals between each service, and the required parts and tools to perform the service.

4. Include separate chapters on each subsystem or major component that make up the emergency generator package. Each chapter will provide exploded view diagrams, required tools, and step by step procedures to repair or replace each component in the subsystem.

If the manuals are incomplete, are lacking in meaningful parts information or step by step repair instructions, or do not cover the model or type of equipment being provided, then the manuals will be rejected and require re-submission.

T639A-7 Warranty.

The packaged emergency generator system must be warranted by the manufacturer against defects in material and workmanship for a period of 1 year from the date of system start-up. The warranty will include parts, shipping costs, rigging costs, engine fluids, labor, and travel expenses, to replace the equipment or repair the equipment in place, in accordance with the manufacturers published service manuals.

Regular and scheduled maintenance will be performed by the Department's maintenance contractor. Requirements for consumables such as oil and filters to be original equipment manufacturer brands are not acceptable and must not void the manufacturer's warranty of the equipment.

T639A-8 Quality.

The emergency generator must be a standard product of the original equipment manufacturer. The vendor that provides the emergency generator package must be an authorized manufacturer's representative for the brand of emergency generator that is provided.

Perform an operational test on the emergency generator and automatic transfer switch before the site is turned over to the Department. After all the site systems and equipment have been installed, placed into service, and individually commissioned by the appropriate party, provide functional testing with all the systems and equipment running simultaneously to verify that the normal operation of any one system or piece of equipment does not interfere or aggravate the normal operation of any other system or equipment. Perform the operational testing with a Department representative present to observe the process.

T639A-9 Construction Requirements.

Install in accordance with manufacturer's written instructions.

The original equipment manufacturers field service personnel will perform the initial start-up of the emergency generator and place the unit in service. The warranty document will show the Florida Turnpike Enterprise as the owner.

Install integral base fuel tank.

Diesel Fuel. Deliver and install #2 diesel fuel oil with less than 15 ppm of sulfur to fill

the diesel fuel tank 90% full. Include fuel additives in proper quantities to increase the Cetane number to 50 minimum, increase the lubricity, and stabilize the fuel. Also add biocide to prevent bacteria and fungi from growing within the fuel tank. After testing the emergency generator, refill the tank to 90 % full.

Identification - Provide engraved plastic nameplates in accordance with the Specifications.

Provide equipotential bonding to the nearest counterpoise loop per the Specifications.

T639A-9.1 Field Quality Control:

Provide field inspection and testing as follows:

1. Over voltage and Under voltage operational test.

The original equipment manufacturers field service personnel will perform the following operational test. Open the generator main circuit breaker before performing the over voltage and under voltage tests.

The manual voltage adjustment on the generator control panel will be used to adjust the generator output voltage up to 120% of nominal voltage to test the over voltage protective device. When the output voltage reaches 120% of nominal for 1 second, the emergency generator shall automatically shut down and the Over Voltage Alarm on the control panel shall initiate. Reset the fault and verify the alarm clears

The manual voltage adjustment on the generator control panel will be used to adjust the generator output voltage down to 80% of nominal voltage to test the under voltage protective device. When the output voltage reaches 80% of nominal for 1 second, the emergency generator shall automatically shut down and the Under Voltage Alarm on the control panel shall initiate. Reset the fault and verify the alarm clears

Return the manual voltage adjustment on the generator control panel to 100% of nominal output voltage after the testing is complete.

2. Load Bank Tests:

A 4-hour continuous load bank test will be performed after the unit is placed into service and all accessories are installed and the permanent fuel system is installed. The test shall be performed with resistive load banks, in the presence of the engineer and if required, the local fire marshal. The test shall be performed during regular business hours only - Monday - Friday, 8:00 AM to 5:00 PM. Run the emergency generator at the following % loads and time periods.

a. 0.5 hour at 50% load
b. 0.5 hour at 75% load
c. 3 hours at 100%
d. Block load at 100% load and verify voltage & frequency dip
e. 0% load for 10 minutes to cool down
f. During test a written log shall be maintained at 15-minute intervals with the following:
g. Ambient Air Temperature
h. Amperes
i. Hertz
j. Oil Pressure and temperature
k. Water Temperature
l. Battery Charging DC voltage and Amps
m. Exhaust Stack Temperature

n. Noise Level in dba (each side)
o. Differential pressure across the radiator

Test the alarm and shutdown circuits by simulating the faults, temperatures, and liquid levels. Verifying the alarm lights energize and the alarm horn sounds. Also verify the alarm silence feature works properly.

After testing the emergency generator, refill the tank to 90 % full.

T639A-9.2 Manufacturer's Field Services:

The manufacturers field service representative shall visit the job site a minimum of three times (sign in each time) after construction begins to coordinate the installation with the Contractor. Provide assistance with concrete pad sizes and shapes, routing and connection points for the control wiring, and proper silencer installation methods.

T639A-9.3 Adjusting and Cleaning:

Adjust the generator output voltage and engine speed. Record for future use.

Touch up paint any scratches on the enclosures or housings in accordance with the manufacturer's instructions. Clean the engine and generator surfaces of grease and oil.

T639A-9.4 Demonstration:

Provide systems demonstration in accordance with Acceptance Procedures for Toll Facilities.

Simulate a utility power outage by interrupting normal power and demonstrate that the system operates automatically to provide standby power to the building. Also simulate a generator over voltage fault condition and observe the engine shutting down, the generator breaker tripping open, and the OV fault lamp illuminated. Clear the faults, close the generator main circuit breaker and restore the emergency generator to the automatic operating mode.

T639A-10 Method of Measurement.

The Contract unit price for each RTC toll site emergency generator will include furnishing, placement, testing and commissioning of all equipment. Also includes providing all tools, labor, equipment, hardware, operational software packages and firmware, supplies, fuel, parts, support, shop drawings, manuals, warranty documentation, and demonstrations, also including all acceptance procedures and incidentals necessary to complete the work. The cost of the fuel tank, fuel, Automatic Transfer Switch and fire extinguishers at each RTC toll site location will also be included in the cost of the toll site emergency generator.

T639A-11 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section.

Payment will be made under:

Item No. 639-13- Emergency Generator-Permanent XX-XX KW - Each

TECHNICAL SPECIAL PROVISION

FOR

ACCEPTANCE PROCEDURES FOR TOLL FACILITIES AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T731
ACCEPTANCE PROCEDURES FOR TOLL FACILITIES AT RTC TOLL SITES

T731-1 Description.

This Section sets forth general administrative and procedural requirements for acceptance of Toll Sites with Roadside Tolling Cabinet(s) for toll gantry(ies) and toll site work.

T731-2 Record Documentation.

Provide Record Drawings, Maintenance Manuals, and Equipment Operational Instructions/Demonstrations. Provide each record documentation in a bound or filed format with prominent identification on the cover, ready for continued use and reference.

The record documents must contain the following identification as a minimum:

T731-2.1 Operating Instructions and Maintenance Manuals.

1. Provide separate manuals for each unit of equipment, each operating system, and each electric and electronic system.

2. Organize operating and maintenance data into suitable sets of manageable size. Bind properly indexed data in individual heavy- duty 2-inch, 3-ring vinyl-covered binders, with pocket folders for folded sheet information. Mark appropriate identification on front and spine of each binder.

3. Submit three (3) copies of each completed manual on equipment and systems, in final form, to the Engineer.

4. Operating instructions and maintenance manuals for each piece of equipment, for each cabinet's operating systems, and each electric or electronic system, must include the following at a minimum:

   a. Equipment or system function
   b. Operating characteristics
   c. Limiting conditions
   d. Performance curves
   e. Engineering data and tests
   f. Complete nomenclature and number of replacement parts
   g. Copies of warranties
   h. Copies of inspection and test reports
   i. Wiring diagrams
   j. Recommended "turn around" cycles
   k. Inspection procedures
   l. Shop Drawings and Product Data
   m. Fixture lamping schedule
   n. Inspection and test reports

5. Provide manufacturer's information for each component of an equipment or system including:

   a. Printed operating and maintenance instructions
   b. Assembly drawings and diagrams required for maintenance
   c. Parts manuals
   d. List of items recommended to be stocked as spare parts

6. Provide information detailing essential maintenance procedures, including:

   a. Routine operations
   b. Trouble-shooting guide

c. Disassembly, repair, and reassembly
d. Alignment, adjusting and checking

7. Provide information on equipment and system operating procedures, including:
a. Start-up procedures
b. Equipment or system break-in
c. Routine and normal operating instructions
d. Regulation and control procedures
e. Instructions on stopping
f. Shut-down and emergency instructions
g. Summer and winter operating instructions
h. Required sequences for electric or electronic systems
i. Special operating instructions

8. Servicing Schedule: Provide a schedule of routine servicing and lubrication requirements, including a list of required lubricants for equipment with moving parts.

9. Controls: Provide a description of the sequence of operation and as-installed control diagrams by the control manufacturer for systems requiring controls.

10. Coordination Drawings: Provide each Contractor's coordination drawings. Provide as-installed color-coded piping diagrams, where required for identification.

11. Valve Tags: Provide charts of valve tag numbers, with the location and function of each valve.

12. Circuit Directories: For electric and electronic systems, provide complete circuit directors of panelboards, including the following:
a. Electric service
b. Controls
c. Communication

T731-2.1.1 Record Drawings.

1. Maintain a set of documents that indicates the actual installation and/or location where the installation and/or location varies substantially from the Work as originally shown due to Addenda, Alternates, Change Orders, Field Orders, etc. Make note of concealed elements that would be difficult to measure and record at a later date.

2. Note related Change Order numbers where applicable.

3. Review the completed Project Record Drawings and ascertain that all data furnished on the prints is accurate and truly represents the Work as actually installed.

4. Submit the record drawing prints, including those changed and unchanged, to the Engineer for compliance review.

5. Make all necessary changes to the record drawings based on the Engineer's review.

T731-3 As-Built Documents.

Provide As-Built Plans prior to issuing Final Acceptance of each toll facility in accordance with the Chapter 5.12 Final As-Built Plans Process of the Construction Project Administration Manual (TOPIC No. 700-000-000).

As-Built Plans must document changes to contract plans and include the following at a minimum:

1. Changes to site layout such as barrier, sidewalks, equipment foundations, dry wells, maintenance pull-off areas, limits of gravel, and driveways.

2. Actual routing and elevations of underground conduit and duct.

3. Actual locations and elevations of pull boxes and manholes.
4. Actual locations of components, grounding electrodes, and inspection wells.
5. Actual locations and sizes of electrical equipment, devices, and boxes.
6. Actual locations, sizes and routing of raceways, conductors, and cabling.
7. Any panelboard changes and circuit number changes including approved combining of circuits and any changes in the home run outlet boxes.

T731-4 Manufacturer and Supplier Warranties.

All manufacturer and equipment supplier warranties shall commence on the Date of Final Acceptance of the total Contract.

Written warranties made to the Department are in addition to implied warranties, and shall not limit duties, obligations, rights, and remedies otherwise available under the law, nor shall warranty periods be interpreted as limitations on time in which the Department can enforce such other duties, obligations, rights, or remedies.

The initiation of warranty for Security, AC, Communication, and Standby Power Systems will commence only when these systems are functioning properly and accepted in writing by the Department.

Complete all repairs or replacements resulting from a breach of warranty promptly.

Submit written warranties to the Department prior to the Date of Final Acceptance. If the Department designates a commencement date for warranties other than the Date of Final Acceptance, or a designated portion of the Work, submit written warranties on the Department's request.

Submit properly executed warranties from the supplier or manufacturer, or a combination thereof.

T731-5 Final Cleaning.

Immediately prior to Final Acceptance, clean each surface or unit of Work to normal "clean" condition expected for a first-class cleaning and maintenance program. Comply with manufacturer's written instructions for cleaning operations. Cleaning includes but is not limited to the following:

1. Remove labels which are not required as permanent labels, including all gum and glue residue.
2. Clean exposed exterior and interior hard-surface finishes, to a dirt-free condition, free of dust, stains, films, and similar noticeable distracting substances. Except as otherwise indicated, avoid disturbance of natural weathering of exterior surfaces. Restore reflective surfaces to original reflective condition. Buff out scratches and marks on exposed metal surfaces.
3. Wipe surfaces of mechanical and electrical equipment clean; remove excess lubrication and other substances.
4. Remove noticeable paint marks and construction stains in concrete slabs and sidewalks.
5. Clean light fixtures and lamps to function at full efficiency. Replace any damaged lens.

Clean each toll site in accordance with Section 4-6 and the following:

6. Remove litter and foreign substances which includes removal of stains, petrochemical spills, and other foreign deposits.
7. Sweep paved areas to a broom-clean condition.
8. Rake grounds that are neither planted nor paved, to a smooth, even-textured surface, breaking up or removing clumps of material.

9. Clean exposed exterior of cabinets and wire troughs, to a dirt-free condition, free of dust, stains, and films.

T731-6 Toll Site Acceptance.

Toll site acceptance procedures include the following:

1. Verification of pre-substantial completion
2. Toll Site Interim Acceptance
3. Toll Site Final Acceptance

Contractor access is prohibited into the toll site after Toll Site Interim Acceptance except as required for Final Acceptance procedures.

T731-6.1 Verification of Pre-Substantial Completion.

Use the checklists included in this TSP to document the completion of all toll site items. The Engineer will verify that all items on the appropriate checklists are completed, and all outstanding items are corrected and recorded as complete on the checklist. The checklists for Roadside Tolling Cabinet (RTC) sites is titled "Toll Site Acceptance Checklist – Type 3 (RTC with Non-Accessible Gantry Sites)". Additional checklists 731-6-1 through 731-6-5 for operational walk-through are also included here.

A copy of the checklists may be obtained from the Engineer at the pre-construction conference.

T731-6.2 Toll Site Interim Acceptance.

Toll Site Interim Acceptance procedures includes the following:

1. Primary Walk-through(s)
2. Operational Testing Walk-through(s)
3. Equipment Demonstrations for Maintenance Personnel

Complete the following prior to the Primary Walk-through:

1. Verify that all items on the appropriate checklists identified in T731-6. are completed and all outstanding items are corrected and recorded as complete on the checklist.

2. The roadway pavement surface course and permanent striping in its final alignment for the toll loop pavement area (100 feet of pavement centered on the gantry) are installed and accepted by the Department and, the approach and departure roadway is available for the Toll Equipment Contractor's (TEC's) use:

a. 3500 feet of roadway at each mainline tolling gantry (2000 feet of approach and 1500 feet of departure).

b. 2500 feet of roadway at each ramp tolling gantry (1500 feet of approach and 1000 feet of departure) or as length of ramp permits for the TEC testing activities' posted speed.

3. Complete sodding per the roadway component plans around each toll site.

4. Provide at least two portable toilets at each toll site for the exclusive use of the FTE and the TEC personnel, during toll equipment installation, commissioning, and testing.

T731-6.2.1 Primary Walk-through is conducted by the Engineer and the FTE Tolls personnel in conjunction with the Contractor's representative to ensure that the toll site has been constructed in compliance with the contract documents and that all elements of the toll site meet the needs of the Department and TEC.

Primary Walk-through shall be repeated until all the requirements as delineated in the contract documents for the toll site have been completed by the Contractor and verified by FTE Tolls.

T731-6.2.2 Operational Testing Walk-through is conducted by the Engineer and the FTE Tolls personnel in conjunction with the Contractor's representative demonstrating successful operational tests and performance verification.

Before the Operational Tests begin, the facility must be clean and all unused materials and equipment must have been removed. After successful completion of the operational tests, the toll facility and equipment will be locked and secured by the Department.

Provide all labor, materials, equipment and services necessary to perform operational tests and performance verification testing for system acceptance.

The contractor will perform the operational tests and a Department representative will observe the process.

1. Stand Alone Tests: Test stand-alone functions of all electrical devices. If any unit fails to pass the stand-alone test, correct the unit or replace another unit instead and then repeat the test.

2. System Acceptance: occurs after all electrical devices have been installed, individually commissioned and Stand Alone Tests have been completed.

a. The systems and equipment will be functionally tested with all the systems and equipment running simultaneously to verify that the normal operation of any one system or piece of equipment does not interfere or aggravate any other system or equipment.

3. An important component of this process is providing the Department with the operation manuals, service manuals, parts manuals, spare parts, keys, system settings, software on discs, and warranty documents for each piece of equipment provided in accordance with the contract documents.

4. A report that shows all systems are functioning properly and the normal operation of any one system or piece of equipment does not interfere or aggravate any other system or equipment will be provided to the Department. The checklists below will be used as the report.

a. If the system or component being tested does not function properly or interferes or aggravates any other system or equipment, then the system will receive a "Fail" grade. Repair or adjust and retest any systems that Fail the operational test.

b. If the system fails the operational test three times, then remove the system or components and replace with a different system or components. Retest the replacement system or components to ensure it is satisfactory

5. Ensure the following systems are energized and operating normally with no alarms:

a. Electrical power distribution system
b. Emergency Power Off Station
c. Emergency generator and fuel tank - ready to operate
d. Automatic transfer switch
e. UPS
f. Cabinet AC systems
g. Lighting
h. [redacted]
i. Outdoor Communications Cabinet
j. Fiber Optic Communications System
k. [redacted]

	Checklist 731-6-1 Lighting	Pass or Fail
1.	Operate the light switches/toggle switches in each area to verify that the lights are controlled in accordance with the plans.	
2.	Operate the outdoor lights and site lighting. Cover the outdoor photocell and observe the outdoor lights as they illuminate. Uncover the outdoor photocell and observe the outdoor lights turn off.	
3.	Confirm that cabinet lighting is activated by door open/close.	

	Checklist 731-6-2 RTC Access Control System Commissioning Procedure	Pass or Fail
1.	Verify the door key(s) for the toll equipment building are available and are on site.	
2.	Open the circuit breaker(s) in the panelboard that will serve the future access control system. Verify the panelboard directory card description is accurate. Leave the breaker open.	
3.	Inspect the cabinet doors latching hardware. Verify each device is present and installed.	
4.	[redacted]	
5.	Use an Ohm Meter to measure the continuity of the request to exit switch contacts in the [redacted] When the sensor detects the presence of a person on the secure side of the door, the request to exit contacts should be closed and the Ohm Meter should measure less that 0.1 Ohm. When the sensor does not detect a person near the door, the request to exit contacts should be open and the Ohm Meter should measure greater than 1 Mega Ohm.	
6.	With the access-controlled door closed, open the door from	

Checklist 731-6-2 RTC Access Control System Commissioning Procedure		Pass or Fail
	the outside (unsecured side) by using the key to unlock it. Verify the key will lock and unlock the door.	
7.	Review the construction plans and verify that each access control raceway and junction box are present.	
8.	Turn over the door keys to the Department representative.	

Checklist 731-6-3 A/C System Lead/Lag Operational Test		Pass or Fail
1.	Check the setting of the thermostat and verify it is set for 75 degrees Fahrenheit. Reprogram thermostat if necessary.	
2.	Measure the dry bulb temperature and relative humidity in the toll equipment building near the center of the room for 1 hour. Ensure the temperature is maintained between 73 degrees and 78 degrees and the relative humidity remains less than 50%.	
3.	Verify that only one A/C unit is running and that one A/C unit running with the 1st stage compressor running will cool the toll equipment building to 75 degrees and less than 50% relative humidity.	
4.	Open the circuit breaker that serves the A/C unit that is running. This is the "Lead" unit. Verify the panelboard directory card description is accurate and agrees with the Name Plate Label affixed to the unit.	
5.	Monitor the other A/C unit (the Lag unit) and verify it starts and begins to cool the room within 60 seconds.	
6.	Close the circuit breaker that serves the A/C unit in step 1 above. Verify the unit is re-energized.	
7.	Repeat steps 4, 5, and 6 for the other A/C unit.	
8.	Measure and record the full load Amperage of each A/C unit when operating with the compressor at 1st stage cooling level. Also measure and record the full load Amperage of each A/C unit when operating at 2nd stage cooling. Verify the full load Amperage when operating in 2nd stage cooling is at least 10% greater than when operating in 1st stage cooling.	Amps 1st ____ Amps 1st ____ Amps 2nd ____ Amps 2nd ____
9.	Turn over the operator manuals and parts manuals to the FTE representative.	

	Checklist 731-6-4 UPS Operational Test	Pass or Fail
1.	Ensure the UPS unit is operating normally with no active alarms and the external UPS Bypass Switch in the NOT BYPASSED mode. Also ensure the clean power panel is energized by the output from the UPS.	
2.	Review the configuration settings that are programmed into the UPS. Verify the settings agree with those provided by FTE during equipment start-up.	
3.	The Department representative will change the default UPS password.	
3.	The FTE representative will telephone Sunwatch and verify: a) The UPS network interface card is communicating and operating satisfactorily. b) The on-site Department provided Network switch is communicating and operating satisfactorily.	a) b)
4.	Locate the circuit breaker(s) that serve the UPS and the external UPS Bypass switch. Ensure the panelboard directory card description is accurate and it agrees with the Name Plate Label affixed to the UPS unit.	
5.	Place the UPS in the Internal Bypass mode. Verify the following: a) The LCD display on the UPS indicates the Bypass Mode. b) Ensure Sunwatch received the "UPS Internal Bypass" alarm? c) Ensure the Department's Network Switch did not re-boot due to loss of power.	a) b) c)
6.	Place the UPS On-Line (not in Internal Bypass). Verify the following: a) The LCD display on the UPS indicates the Normal Mode. b) Ensure Sunwatch received the "UPS No Longer In Internal Bypass" alarm? c) Ensure the Department Network Switch did not lose power or re-boot due to a power disruption.	a) b) c)
7.	Place the UPS external maintenance bypass switch in the "UPS Bypassed" position. Ensure the Department network Switch did not lose power or re-boot.	
8.	Place the UPS external maintenance bypass switch in the "UPS" position. Ensure the Department network Switch did not lose power or re-boot due to a power disruption.	

	Checklist 731-6-4 UPS Operational Test	Pass or Fail
9.	Open the circuit breaker that serves the UPS. Verify the following: a) The LCD display on the UPS indicates the reserve battery mode and displays the number of reserve minutes remaining. b) Ensure Sunwatch received the "UPS On Battery" alarm. c) Ensure the Department Network Switch did not lose power or re-boot due to a power disturbance.	a) b) c)
10.	Close the circuit breaker that serves the UPS. Verify the following: a) The LCD display on the UPS indicates the normal mode. b) Verify Sunwatch received the "UPS Normal" alarm. c) Ensure the Department Network Switch did not lose power or re-boot due to a power disturbance.	a) b) c)
11.	Turn over the operator manuals, parts manuals, system passwords, and warranty documentation to the Department representative.	

	Checklist 731-6-5 RTC Engine Generator with Base Tank and Automatic Transfer Switch	Pass or Fail
1.	Open the circuit breaker(s) that serves the engine generator block heater and the battery charger. Verify these items are de-energized. Verify the panelboard directory card description is accurate. Close the circuit breaker(s) that serves the block heater and battery charger.	
2.	Review the configuration settings that are programmed into the generator control panel. Verify the settings agree with those provided by Department during equipment start-up.	
3.	The Department representative will change the default generator controller password.	
4.	Review the configuration settings that are programmed into the Automatic Transfer Switch control panel. Verify the settings agree with those provided by Department during equipment start-up.	
5.	The Department representative will change the default Automatic Transfer Switch control panel password.	

Checklist 731-6-5 RTC Engine Generator with Base Tank and Automatic Transfer Switch		Pass or Fail
6.	Verify the generator controller start/stop switch is in the AUTO REMOTE position. Open the ATS main circuit breaker to simulate a utility power outage. Record the elapsed time between the power outage and power being restored by the generator set & ATS. The maximum acceptable elapsed time is 10 seconds to restore power.	_____ Seconds
7.	The Department representative will contact Sunwatch and verify the "Toll Site on Backup Power" alarm is active.	
8.	While the toll site is being powered from the generator set, verify each UPS is on line, providing power, and the UPSs have no active alarms showing on the operator interface.	
9.	Close the ATS main circuit breaker to simulate a return of utility power. Record the elapsed time between the power restoration and the ATS operating to restore normal utility power. The maximum acceptable elapsed time for the ATS to switch back to Utility power is 15 minutes.	_____ Minutes
10.	Test and observe the High level, Low level, and Leak alarms.	
11.	Use the SCADA control panel operator interface to view the level in the fuel tank. The SCADA system should indicate that the fuel level is between 90% and 95% full.	
12.	Turn over the generator and ATS operator manuals, parts manuals, service manuals, and warranty documents to the Department representative.	

Complete all items on the Operational Testing Walk-through punch lists. Touch-up and otherwise repair and restore marred exposed finishes on the interior of the building. Complete all touch-up painting in the interior. Touch-up and otherwise repair and restore marred exposed finishes on outdoor equipment.

Correct deficiencies identified by the Department.

Upon successful completion of the Operational Testing Walk-Through, make final change-over of permanent locks and transmit keys to the Engineer.

T731-6.2.1 Equipment Demonstrations for Maintenance Personnel.

Provide a competent and experienced person (or persons) thoroughly familiar with the Work to demonstrate to, and instruct the Department's personnel in operation, adjustment and maintenance of products, equipment and systems. This instruction shall include normal start-up, run, stop, and emergency operations, location and operation of all controls, alarms and alarm systems, etc. The instruction shall include tracing the system in the field and on the diagrams in the instruction booklets so that the Department's operating personnel will be thoroughly familiar with both the system and the data supplied. Provide instruction at mutually agreed upon times.

Use operation and maintenance manuals for each piece of equipment or system as the basis of instruction. Review contents in detail to explain all aspects of operation and maintenance. For equipment that requires seasonal operation, provide similar instruction during other seasons.

If installers and/or Contractor's personnel are not experienced in operational procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following: (Items listed are examples only and not all inclusive)

1. Maintenance manuals
2. Record documents
3. Spare parts and materials
4. Tools
5. Lubricants
6. Fuels
7. Identification systems
8. Control sequences
9. Hazards
10. Cleaning
11. Warranties and bonds
12. Maintenance agreements and similar continuing commitments.

As part of instruction for operating equipment, demonstrate the following procedures: (Items listed are examples only and not all inclusive)

1. Start-up
2. Shut down
3. Emergency operations
4. Noise and vibration adjustments
5. Safety procedures
6. Economy and efficiency adjustments
7. Effective energy utilization

Contractor access is prohibited into the tolling site after the TEC has started installation of the tolling equipment.

T731-7 Prerequisites for Toll Site Final Acceptance

Review maintenance and operations in relation with applicable warranties, agreements to maintain, bonds, and similar continuing commitments.

Obtain concurrence from Engineer that the following items have been completed:

1. All additional spare parts as specified in the Contract Documents have been provided to the Department
2. All special tools for items such as louver vanes, adjustable dampers, thermostats, allen-head locking devices, as specified in the Contract have been provided to the Department
3. Record documentation has been provided to the Department in accordance Section T731-2
4. As-Built documentation for the toll facility has been provided to the Department in accordance Section T731-3
5. Manufacturer and supplier warranties have been provided to the Department in accordance Section T731-4

T731-8 Toll Site Final Acceptance

Toll site Final Acceptance must be scheduled after the TEC commissioning has been completed. Toll site Final Acceptance includes completion of the following items:

1. Remove temporary facilities from the site, including portable toilets, construction tools, equipment, and any debris.
2. Inspect the toll site in the presence of Engineer and obtain concurrence from Engineer.

T731-9 Method of Measurement

The work specified in this Section will not be measured separately, but will be included in the pay item for the Outdoor Communications Cabinet.

T731-10 Basis of Payment

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TOLL SITE ACCEPTANCE CHECKLIST
TYPE 3 (RTC NON-ACCESSIBLE GANTRY SITES)

(**ALL** Items must be completed, without deficiencies, and field verified prior to Department acceptance)

Document and report any deficiencies immediately.

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
A	**GANTRY and ASSOCIATED MOUNTING INFRASTRUCTURE**			
1	Toll gantry upright and truss with cable tray supports have been installed per contract documents (CDs).			
2	W-members have been installed per CDs.			
3	All gantry member connections have been installed per the approved shop drawings.			
4	Horizontal support pipes (quantity/size) and hardware (pipe saddle plates, u-bolts, nuts, washers, and bolts) have been installed per CDs.			
5	Toll equipment J-arms, quantity, sizes, and tolerances have been provided and installed per CDs.			
6	Contractor has provided spare horizontal support pipes and mounting hardware per CDs. Contractor has provided spare J-arms and mounting hardware per CDs.			
7	Toll equipment J-arm mounting hardware (pipe saddles, mounting plates, u-bolts, nuts, washers, and bolts) have been provided and installed per CDs and shop drawings.			
8	Measure the vertical clearance from the bottom of each J-arm to the final roadway surface directly below. Document any J-arms mounted beyond the 13"+/- distance from the nominal position and when the bottom of the J-arm is not 18'-6" above the final pavement directly below. The Contractor must submit a remediation plan for review by the Department for any deficiencies.			
9	Verify the lightning protection system has been installed per CDs. Measure and confirm resistance to ground is within specification requirements.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
10	Inspect and verify all infrastructure provided and installed by the Contractor is free from rust and/or corrosion.			
11	Verify any Contractor provided and installed hardware does not have any signs of galling or damage.			
B	**GANTRY ELECTRICAL, WIRE TROUGHS, and E6 READER MOUNTING FRAME**			
1	Fittings, couplings, bushings, and reducers at conduit ends have been installed per CDs.			
2	Strut channels have been installed per CDs. Strut channel ends are installed with PVC caps rated for outdoor use by the strut channel manufacturer.			
3	Rigid conduit and sweeps have been properly installed and secured to the gantry upright.			
4	Ground mounted power, data, and E6 wire troughs have been installed per CDs.			
5	E6 Reader ground-mounted frame with supporting E6 conduit strut channel supports have been installed per CDs.			
6	Rigid conduit has been installed and properly spaced on the strut channel frames per the CDs. All conduit has been installed with pull ropes and correct associated labels.			
7	Rigid conduit terminations in each cable tray have been properly connected, grounded, and sealed.			
8	Equipment cable trays have been securely mounted to the w-members and terminated per the CDs.			
9	Gantry upright cable trays have been securely mounted to the gantry upright per the CDs.			
10	Longitudinal cable trays with dividers for data, E6 readers, and power are supported per the CDs. Cable trays have been properly connected and grounded with manufacturer approved mounting hardware.			
11	Cable tray waterfall fittings have been properly installed per CDs.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
12	When vertical junction boxes (pencil pull boxes) are shown in the CDs, verify the metallic conduit entering and leaving each vertical junction box (pencil pull box) have been installed and secured to: - Gantry upright and supports - Pencil pull boxes			
13	Conduit runs from upright to roadside and/or median pull box per CDs have been properly installed, secured, and sealed.			
14	E6 Reader frame has been installed per CDs and includes: - Galvanized strut channel - Strut channel mounting hardware - Ground bar with mounting hardware - Grounding conductor bonded to counterpoise			
15	Each E6 Reader's infrastructure (fiberglass enclosure and mounting plate) has been properly installed and grounded.			
C	**GANTRY TO OUTDOOR COMMUNICATIONS CABINET (OCC) CONDUIT CONNECTIONS**			
1	Verify the gantry wire trough connectivity per CDs: [redacted] - Each conduit is terminated with a bushing and grounded within the wire trough			
2	Conduit stub-ups are precisely aligned, spaced, and arranged within the OCC "Working Space".			
3	All conduit have been installed with pull ropes and correct associated labels.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
D	**GANTRY TO ROADSIDE TOLLING CABINET (RTC) CONDUIT CONNECTIONS**			
1	Verify the gantry wire trough connectivity per CDs: - E6 Reader conduit to the RTC Working Space, and future RTC pull box - Data conduit to the RTC Working Space and future RTC pull box - Power conduit to the RTC Working Space, and future RTC pull box - Each conduit is terminated with a bushing within the associated wire trough			
2	When vertical junction boxes (pencil pull boxes) are shown in the CDs, verify the pencil pull box connectivity to the RTC: - E6 Reader conduit to the RTC Working Space, and future RTC pull box via the data pull boxes - Data conduit to the RTC Working Space and future RTC pull box via the data pull boxes - Power conduit to the RTC Working Space, and future RTC pull box via the power pull boxes			
3	All conduit have been installed with pull ropes and correct associated labels.			
4	Conduit stub-ups are precisely aligned, spaced, and arranged within the RTC Working Space per CDs.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
E	**TOLL LOOP INFRASTRUCTURE**			
1	Toll loop pavement (FC-12.5) and final striping have been installed per CDs.			
2	Toll loop conduit stub-ups with pull ropes have been installed and sealed per CDs.			
3	Field verify each conduit is free and clear of debris or foreign material.			
4	Toll header curb has been installed per CDs.			
5	Toll loop pull boxes have been installed per CDs.			
6	Verify the 3" interconnect conduits with pull ropes between the toll loop pull boxes have been installed per CDs.			
7	Verify conduit home runs with pull ropes from the toll loop pull boxes to the Roadside Tolling Cabinet (RTC) and future RTC pull box have been installed per CDs.			
8	Applies to concrete pavement ONLY: Field verify each loop conduit with pull rope has been sealed, routed, and stubbed up to the location specified in CDs.			
9	Field verify the cable distances for furthest toll equipment as per CDs.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
F	**SITE ELECTRICAL:**			
1	Utility power (pad mounted transformer) has been installed, tested and certified by the CEI and service provider. Document physical address.			
2	Stand-by power generator with base fuel tank has been installed, grounded, tested, and certified per CDs. - Generator control panel - Generator circuit breaker - Generator batteries - Jacket water heater [redacted]			
3	Ground wells have been installed, tested and certified per CDs.			
4	Verify each metal wire trough, power distribution frame(s) (PDFs), and emergency generator with base fuel tank are connected to their associated ground wells.			
5	Field verify the fuel tank is 90% full. The contractor must provide a transmittal to the CEI certifying the sulfur content of the diesel fuel, the Cetane number, and the type and amount of biocide added to the fuel.			
6	Power Distribution Frame (PDF) has been installed per CDs. - Meter - Electrical Distribution Panel (EDP) - Transfer Switch [redacted] - Lighting - Fire extinguisher with cabinet			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
G	**OUTDOOR COMMUNICATIONS CABINET (OCC)**			
1	OCC has been installed, mounted, and grounded per the CDs. Cabinet must include: - (2) cabinet mounted air conditioning units (ACs) - AC units lead lag controller - Sun shields - Slide out shelf - Lighting - UPS devices with network interface cards [redacted] - ITS fiber distribution panel - Telco (as applicable) [redacted] - Convenience receptacle - Stand-by power from generator - Door contacts - Leak detector			
2	Conduit between the OCC and RTCs have been installed within the Working Spaces / pull box. - Clean power [redacted] - ITS FOC - Telco [redacted] - Clean power - Stand-by power - Coiled CAT 5Es conductors inside OCC for future connections to RTC(s)			
3	Conduit stub-ups are precisely aligned, spaced, and arranged within the OCC and RTC Working Spaces per CDs.			
4	UPS units have been installed, tested, and certified. A network interface card must be installed for external [redacted] Field verify the UPS alarms have been received at SunWatch located next to Turkey Lake Headquarters.			
5	[redacted] raceway have been installed and terminated at the proper cabinet position and location.			

TOLL SITE NAME: Date: ___ / ___ /20__

CEI Inspector Name(s):

FTE Inspector Name(s): FPID: XXXXXX-X/X

DIRECTION (XB): MP: Station:

Item ID	Inspection Item	Item Completed YES / NO	Tolls Accepted YES / NO	Field Observations and Issues Noted Begin note with: (Not Started, Work In Progress, or Completed)
H	**OCC AC SYSTEM**			
1	New exterior AC units have been installed, tested, and certified with an operational control system including the lead lag controller per the CDs.			
2	Field test both AC units can operate in both lead and lag operations per CDs. Verify lead lag controller has been programmed per the CDs.			
3	Condensate dry wells and piping has been installed and tested per CDs.			
I	**OCC FIBER OPTIC COMMUNICATIONS INFRASTUCTURE and DEVICES**			
1	Fiber distribution panel and fiber optic cable connection from the backbone-to-OCC have been installed, tested, and certified per CDs.			
2	Connection from the backbone-to-OCC has been installed per CDs: - Fiber optic manhole splices per CDs. - Pull boxes - Conduit, including empty spares - Termination in the patch panel has been completed - Tone wire, (not installed in Tolls' spare conduit) - Warning tape - Standard route markers have been installed per Standard Specification 630 - Each FOC lateral has a minimum of (1) one standard route marker at the midpoint and (1) one at each turn (3 minimum)			
J	**RFIs and Shop Drawings**			
1	All RFIs have been answered and accepted.			
2	All shop drawings have been submitted, accepted, and closed out.			
3	All CEI submittals as per CDs have been received and accepted.			
P	**DATE OF TOLL SITE DEPARTMENT ACCEPTANCE**			
1	Document date of acceptance.			

TECHNICAL SPECIAL PROVISION

FOR

TOLL SITE DRY WELL AND ACCESSORIES AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T737
TOLL SITE DRY WELL AND ACCESSORIES AT RTC TOLL SITES

T737-1 Description.

Furnish and install the condensate drainage and refrigerant piping systems complete with all supports, hangers, specialties, and accessories as shown on Plans and herein specified.

T737-2 Materials.

Provide new materials free from defects and of American manufacture, and clearly marked with manufacturer's name and weight, classification, or working pressure of pipe and fitting.

T737-2.1 Pipe:

The following schedule covers the materials which shall be furnished and installed unless otherwise specified under the system section:

Materials	Service
PVC non-pressure pipe in accordance with Section 948	Condensate Piping
Precast Concrete Pipe Class IV in accordance with Section 449	Precast Concrete Pipe (for Dry Well)

T737-2.2 Pipe Fittings:

1. All PVC socket type connections shall be made with PVC solvent cement complying with ASTM D 2564.

2. Air Gap Fitting: Coated cast iron air gap fitting with integral cast air ports, female threaded inlet and outlet.

T737-2.3 Pipe Hangers and Supports

Provide hangers and supports for the different applications as follows:

1. Plumber's strap shall not be used.

2. Pipe Saddles: 18 gauge galvanized iron, 12 inches long (min.) installed at all points where insulated lines bear on hangers.

3. Supports shall be generally capable of maintaining the installed load plus 500 lb. Support copper tubing at 6-foot (max.) intervals horizontally. Support PVC piping every 4 feet.

T737-2.4 Pipe Sleeves for Toll Equipment Buildings

1. Interior: Galvanized sheet metal, 22 gauge. Provide for pipe passing through walls or floors before pouring concrete. Plastic sleeves are permitted.

2. All sleeves shall be large enough to allow full thickness of insulation through sleeves for insulated piping, and for two layers of 30 lb. felt wrapping around un-insulated piping.

T737-2.5 Condensate Dry Well

Provide precast concrete pipe for dry well, with the bell end supporting a H-20 traffic rated manhole cover and frame as shown on the Plans.

T737-3 Submittals and Shop Drawings.

Submit manufacturer's technical data sheets and shop drawings for approval on all pipe, fittings, valves, hangers and supports, sleeves and specialties as listed in this Technical Special Provision before any work is commenced. Submit plumbing and piping erection drawings.

T737-4 Construction Requirements.

T737-4.1 General

The Plans are generally diagrammatic. They do not show every bend, offset, elbow or other fittings which may be required in the piping for installation in the space allotted. Careful coordination of the work of this Technical Special Provision with that of other Divisions is necessary to avoid conflicts.

Line and Grade: Install gravity lines at uniform grade to low point after field verification of low point invert.

T737-4.2 Delivery, Storage, and Handling

1. Provide factory-applied plastic endcaps on each length of pipe and tube. Maintain endcaps through shipping, storage and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.

2. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate above grade and enclose with durable, waterproof wrapping.

3. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

T737-4.3 Pipe Sleeves

1. Place all sleeves for piping prior to the pouring of concrete or in time to set in place as masonry walls are erected.

2. After piping is installed through the sleeves, complete with insulation or wrapping, the sleeves shall be sealed water-tight with an approved mastic or caulking compound.

T737-4.4 Jointing Pipe

1. Provide nipples of same material and weight as pipe used. Part of standard weight nipples is less than 1-1/2 inches.

2. Provide reducing fittings where changes in pipe sizes occur.

3. Provide unions or flanges in all service lines at each piece of equipment, specialty, valves or at other locations required for ready disconnect.

4. Provide all necessary drain piping from the low point of each of the systems, and other miscellaneous piping required by the various systems to make a complete installation. Drains shall not be smaller than connection at equipment and no drain shall be smaller than 3/4 inch.

T737-4.5 PVC Pipe:

1. Remove all burrs from cut ends of PVC piping with knife, deburring tool or file.

2. Visually inspect the inside of pipe and fitting sockets and remove all dirt, grease or moisture with chemical cleaner and wipe clean with cloth prior to application of solvent.

3. All thermoplastic pipe installed underground shall be installed in accordance with ASTM D2321.

T737-4.6 Pipe Hangers and Supports

1. Provide brackets, rolls, clamps and supplementary steel as required for proper support of pipelines. Design hangers to allow for expansion and contraction of pipelines and of adequate size to permit covering to run continuously through hangers. Support piping at equipment independently so that no weight will be supported by equipment. Coordinate location of hangers with light fixtures. Wire brush all steel or iron supports and prepare surfaces under this Technical Special Provision for painting.

2. Special Supports: All clamps, hangers and supports required by equipment manufacturers, shall be furnished and installed as per their recommendations.

3. Plumber's tape, straps, chain, wire hangers, or perforated bar must not be allowed as a means for hanging pipe.

T737-4.7 Equipment Connections

1. Make connections between equipment and the piping systems as shown and specified.

2. Make connections between any piece of equipment and any piping system by means of unions, flange joints or other fittings which permit equipment to be disconnected and removed for maintenance.

T737-4.8 Condensate Dry Well

1. Field coordinate with civil site and grading plans, utility plans, and all other trades for the exact location of the condensate dry well.

2. Do not locate dry well in the direct path of the site conduits.

T737-5 Method of Measurement.

Toll site dry well and associated condensate piping will include furnishing, placement, and testing of all materials, equipment, and for all tools, labor, equipment, hardware, supplies, parts, support, shop drawings, manuals, warranty documentation, and demonstrations. Also include all acceptance procedures and incidentals necessary to complete the work.

The work specified in this Section will not be measured separately, but will be included in the pay item for the Outdoor Communications Cabinet.

T737-6 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

FIRE EXTINGUISHERS AND ACCESSORIES AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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Fla. License No.: _____
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Firm Address: _____
City, State, Zip Code: _____

SECTION T738
FIRE EXTINGUISHERS AND ACCESSORIES AT RTC TOLL SITES

T738-1 Description.

Furnish all labor, materials, services, testing, and equipment necessary to provide and install fire extinguishers with associated mounting accessories at Toll Facilities in accordance with the Plans and Specifications.

T738-2 Materials.

T738-2.1 Standards: Fire extinguishers and accessories must meet the following applicable industry standards:

1. National Fire Protection Association (NFPA): NFPA 10 - Portable Fire Extinguishers.
2. All fire extinguishers shall be Underwriters' Laboratories (UL) approved and labeled or by other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7 to provide procurement flexibility.

T738-2.2 Furnish and install a multi-purpose, dry chemical stored pressure type UL listed fire extinguisher with the following material characteristics:

[redacted]

T738-2.3 Furnish and install wall bracket-mounted fire extinguishers where indicated on the Plans. Furnish and install weatherproof surface mounted fire extinguisher cabinets at locations indicated on the Plans in accordance with the following:

1. Size: To suit type of unit being housed.
2. Frame Finish: Metal trim.
3. Door: Metal trim with 1/4-inch clear acrylic or tempered safety glass.
4. Signage: Identify extinguisher cabinets with manufacturer's standard red lettering applied to cabinet door, spelling "FIRE EXTINGUISHER".

T738-3 Submittals and Shop Drawings.

Submit manufacturer's technical data indicating compliance with the requirements and installation instructions for fire extinguishers, weatherproof cabinets, and accessories. Submit attachment details for exterior wall mounted, interior wall mounted and power distribution frame mounted fire extinguishers.

T738-4 Quality Assurance.

Provide new UL-listed fire extinguishers bearing UL "Listing Mark" for type, rating, and classification of extinguishers indicated. Provide fire extinguishers, cabinets, and accessories by single manufacturer.

T738-5 Construction Requirements.

Verify servicing, charging, and tagging of all fire extinguishers. Install the fire extinguishers and mounting accessories in strict accordance with the original design, approved shop drawings, NFPA 10, and requirements of agencies having jurisdiction, anchoring all components firmly into position.

T738-6 Method of Measurement.

The work specified in this Section will not be measured separately, but will be included in the pay item for Panelboards.

T738-7 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

GENERAL REQUIREMENTS FOR TOLL SITE FACILITIES' ELECTRICAL INFRASTRUCTURE AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T740
GENERAL REQUIREMENTS FOR TOLL FACILITIES'
ELECTRICAL INFRASTRUCTURE AT RTC TOLL SITES

T740-1 Description.

This section includes general electrical requirements specifically applicable to toll site infrastructure.

T740-2 Materials.

1. All electrical equipment and materials used on this project shall be fully rated and new (not used or reconditioned). Electrical equipment and machinery shall be of the most current designs and models.

2. Unless otherwise noted, all material shall be listed / labeled by UL or another National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.

3. Where multiple items of the same equipment or materials are required, furnish and install products of the same Manufacturer.

4. Material and equipment shall be provided complete and shall function up to the specified capacity or function. Should any material or equipment, as a part or as a whole, fail to meet the performance requirements, the material or equipment shall be replaced or repaired to bring the performance up to the specified requirements. Damages to the finish or the paint by such replacements, alterations, or repairs shall be restored to prior conditions, at no additional cost to the Department.

5. Where tamperproof screws are specified or required, Phillips head or Allen head screws are not acceptable as tamperproof. For each size or type used, provide the Department with three tools. If existing tamper proof equipment exists on the job site, the screw heads shall match the existing.

T740-3 Standards.

Systems, equipment, materials, and accessories that are assembled or installed in a toll equipment building (TEB) shall comply with the following:

1. Florida Building Code, Current Edition in effect.
2. Florida Fire Prevention Code and the publications as referenced in NFPA 1 – Uniform Fire Code (the Current Edition in effect) and NFPA 101 – Life Safety Code (the Current Edition in effect).

T740-4 Submittals and Shop Drawings.

1. Submit specific shop drawings which indicate the fabrication, assembly, installation, and erection of systems' components. Drawings that are part of the Plans shall not be considered a substitute for required shop drawings.

2. The Plans describe specific sizes for the electrical systems' basis of design. These sizes are based on specific items of power consuming equipment (lights, motors for fans, etc.). Coordinate the requirements of each load with each load's actual nameplate data and manufacturer's published electrical criteria.

3. Coordinate with the approved shop drawings from all required disciplines and verify final electrical characteristics before roughing in the power feeds to any equipment. When

electrical data on approved shop drawings differs from that shown or called for in the Plans, make adjustments to the wiring, disconnects, and branch circuit protection to match the installed equipment's requirements.

4. Submit a detailed site conduit drawing at a scale of 1" = 20' prior to the start of Work. Prepare a separate set of drawings for each toll site and show the site-specific name in the title block. Show routing of each conduit from origin to termination point. Coordinate the exact location of conduit stub-ups within the available working spaces.

5. Provide the following:

a. Show locations of conduits, racking, junction boxes, panelboards, safety switches, receptacles, light switches, control panels, UPS units, bypass switches, and surge protection devices,.

b. Submit detailed conduit routing drawings at a scale of ¼" = 1' for the enlarged site plan prior to the start of Work. Prepare a separate set of drawings for each toll site and show the site-specific name in the title block. Show conduit stub-ups under the OCC Cabinet and RTC Cabinets. Show routing of each conduit from origin to termination point. Coordinate the exact location of conduit stub-ups with the available working spaces.

c. Submit an arc flash hazard analysis, in accordance with the latest version of the Standard for Electrical Safety in the Workplace, NFPA 70E. An arc flash hazard analysis determines the arc flash protection boundary and the personal protection equipment (PPE) that people within the arc flash boundary must use. Field install arc flash and shock warning labels on each piece of new electrical distribution equipment such as panelboards, safety switches, motor control centers, and automatic transfer switches. The labels must indicate the flash hazard boundary, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.

T740-4.2 As-Built Documents:

In the As-Built documents, show all components including but not limited to:

1. Raceways 3/4" and above, cable tray systems, including dimensions from fixed lines such as slab edges
2. Site underground raceways and duct banks
3. Pull boxes and manholes including elevations
4. Lighting
5. Junction boxes 6"x6" and larger must be shown in exact location
6. Any combining of circuits (which is only allowed by specific permission) or change in homerun outlet box must be indicated
7. Circuit number changes
8. Conductors and cables, cable sizes, raceway sizes, etc.
9. Panelboard changes, including load changes
10. Location of lighting control devices such as photocell controls, switches, etc.
11. Wireway and cable tray systems
12. Exact location of driven grounding electrodes
13. Locations of grounding and lightning protection ground loops
14. SCADA system control panels and associated electrical devices, connections, and power supplies as depicted on the toll facility plans
15. Riser diagrams exactly as installed

16. Panelboards, equipment racks, disconnects, and switches and surge-protective devices

17. Update the toll facility plan notes to match with items actually furnished, actual installation methods, etc.

T740-4.3 Warranty

1. The warranty will cover the materials and workmanship required to complete the project. The warranty shall be provided by the Contractor to the Department and shall include labor and materials for a minimum period of one year from date of Final Acceptance of the total Contract unless extended by the Contractor's proposal.

2. Where extended warranties or guarantees are called for herein, furnish three copies to be inserted in the Operation and Maintenance Manuals.

3. All preventative maintenance and normal service will be performed by the Department's maintenance personnel after Final Acceptance. This shall not alter the Contractor's one year warranty or the manufacturer's warranty of the installed equipment.

T740-5 Construction Requirements.

T740-5.1 General:

1. Wiring arrangements for equipment shown on the drawings are intended to be diagrammatic and do not show all required conductors and functional connections. Provide all items to form a complete and operating system.

2. Electrical distribution systems for toll facilities must be selectively coordinated systems. The protective features of the electrical distribution system will automatically and selectively isolate a faulted or overloaded circuit from the remainder of the electrical system. Only the closest protective device to the fault will operate to isolate the fault without affecting other parts of the system.

3. Obtain all new physical addresses that may be required for the initiation of new electric and/or communication services and pay any required costs and fees. Coordinate and verify power company service requirements prior to material procurement and installation of service equipment.

4. Occupied buildings must remain in operation while the new work is being performed. Schedule work for a minimum outage to the Department. Reroute existing conduit and wiring in areas under construction such that the building systems remain active and useable for the building occupants. Notify the Engineer and facility manager 48 hours before any shut-down of existing systems.

5. Coordinate with the Contractor for construction phasing. Renovation projects require the existing electrical systems to remain operational while the renovation work takes place.

6. Verify that the physical dimensions of the equipment will allow for proper installation in the space allotted on the drawings and with NEC working clearances.

7. Verify finish dimensions at the project site in preference to using dimensions noted on the Plans.

8. Electrical equipment shall be protected from the weather during shipment, storage, and construction per the manufacturer's recommendations. Should any equipment be subjected to damage by water, it shall be replaced without additional cost to the Department.

9. Inspect all electrical equipment and materials prior to installation. Damaged equipment and materials shall not be installed or placed in service. Replace or repair the damaged equipment (in compliance with industry standards) at no additional cost to the Department. Any equipment and/or testing required for the repairs shall be provided by the Contractor.

T740-5.2 Supervision of the Work:

1. A qualified and experienced electrical superintendent shall be in charge of the work in progress at all times. If, in the judgment of the Department's representative, the electrical superintendent is not performing duties satisfactorily, the General Contractor shall immediately replace him upon receipt of a letter of request from the Department. Once a satisfactory electrical superintendent has been assigned to the work, he shall not be withdrawn by the Electrical Contractor without the written consent from the Department.

2. Provide field superintendent(s) who have a minimum of four years previous successful experience on projects of comparable sizes and complexity. Superintendent shall be present at all times that work under this Division is being installed or affected.

T740-5.3 Coordination:

Provide the labor and materials required to electrically connect all the items and equipment served by the power distribution systems in the toll facilities and tolling gantries that are identified in the contract documents. Include all required coordination and supervision where work connects to or is affected by the work of others.

T740-5.4 Provision for Openings: Perform the following for all toll equipment buildings depicted on the Toll Facility Plans.

1. Locate openings required for work. Provide sleeves, guards or other approved methods to allow passage of items installed.

2. Coordinate with roofing Contractor on installation of electrical items which penetrate the roof or are mounted on the roof. Roof penetrations shall be installed so as to not void the roof warranty.

3. Where work pierces any waterproofing, it shall maintain the integrity of the waterproofing. Coordinate the work which pierces the waterproof barrier with the General Contractor.

4. Coordinate with Fabricated Structures Manufacturer on installation of electrical items which penetrate the Toll Equipment Building floor, walls and ceiling.

5. Field verify all conduits installation penetrating the foundation to ensure that conduit layout is completed prior to the foundation pour.

T740-5.5 Concrete Pads: Furnish and install reinforced concrete pads for transformers. Unless otherwise noted, pads shall be four (4) inches high and shall exceed the dimensions of the equipment being set on them, including future sections, by six (6) inches on each side. The concrete pads will be reinforced with 6x6-W1.4xW1.4 welded wire mesh. Trowel all surfaces smooth.

T740-5.6 Cutting and Patching:

1. Provide cutting and patching necessary for the installation of electrical infrastructure.

2. Materials impacted by cutting and patching must be refinished to match specified finish.

3. Schedule work to avoid as much cutting and patching as practical.

T740-5.7 Trenching and Backfilling:

1. Place backfill at new grades to match adjacent undisturbed surface.

2. See Section 120 for trenching, backfilling, and compaction requirements.

3. Comply with OSHA Standard 29 C.F.R.s. 1926. 650 Subpart P for trench excavation.

T740-5.8 Delivery, Handling, Protection of Materials, and Storage:

1. Ship, deliver, and store products in the manufacturer's protective packing to prevent damage.

2. Handle equipment carefully to prevent damage to components, breakage and denting or scoring of surfaces and finishes.

3. Store all equipment and products in clean, dry spaces. Protect all equipment from dirt, fumes, water, chemicals, construction debris and physical damage. Any equipment exposed directly to moisture will not be acceptable and shall be replaced.

4. Replace damaged products and equipment. Repair and repaint marred and damaged finishes to original factory finish as directed by manufacturer and as specified.

5. Keep all conduits and other openings protected against entry of foreign matter.

T740-5.9 Installation: Install / use in accordance with any instructions included in the listing or labeling. Furnish and install supports and anchorage of electrical equipment.

T740-5.10 Waste Materials Disposal: Comply fully with Florida Statute 403.7186 regarding mercury containing devices and lamps. Lamps, ballasts and other materials shall be transported and disposed of in accordance with all DEP and EPA guidelines applicable at time of disposal.

T740-6 Shop Drawings Processes.

T740-6.1 Description.

Shop drawing submittals - List the project title and the contractor information on the first sheet of each shop drawing. Include the site-specific name of the building or site, the subcontractors, engineers, contact names, and telephone numbers.

1. Submit a shop drawing that includes specification sheets, catalog sheets, schematics, manuals, etc. for each separately numbered specification section in the Index of the Technical Special Provisions (TSP). If the project will not use any products from a TSP section, then submit the shop drawing with a note indicating "No products or materials from this TSP section will be installed on this project."

2. The following shop drawing sections must be compatible and operate together as a system when depicted on the Toll Facility plans:

a. Dual AC Control System and Sequence of Operation

b. Ductless Split System Air Conditioners

c. Fuel Oil Piping for TEB sites only

d. Concrete Protected Above Ground Fuel Storage Tank for TEB sites only

e. Supervisory Control and Data Acquisition

f. Panelboards

g. Emergency Generator

h. Static Uninterruptible Power Supply

i. Automatic Transfer Switch

j. Service Entrance Automatic Transfer Switch for RTC sites with on-site-power

3. The following shop drawing sections must be compatible and must be coordinated for installation of the electrical conduits entering toll equipment buildings when depicted on the Toll Facility plans:

a. Fabricated Structures

b. Common Work Results for Electrical

4. Submittal product data shall be presented in a clear and thorough manner. Clearly mark each sheet to identify pertinent products or models applicable to this project. Indicate all optional equipment and delete or cross out non-pertinent data. Markings shall be made with arrows, circles or underlining. Highlighting is not acceptable.

5. Partial shop drawings for a TSP specification section are not acceptable and will not be reviewed. Ensure each shop drawing submittal is complete and includes all the products, materials, manuals, etc. specified in the particular TSP section.

6. Drawings, riser diagrams, wiring diagrams, and schematic diagrams shall include identification of the project name, and the specific site name when multiple sites are included in the same project.

7. Product Data: Technical product data is required for all items as called for in the specifications regardless if item furnished is as specified.

a. Submit technical data verifying that the item submitted complies with the requirements of the specifications. Technical data shall include manufacturer's name and model number, dimensions, weights, electrical characteristics, and clearances required. Indicate all optional equipment and changes from the standard item as called for in the specifications. Furnish drawings, or diagrams, dimensioned and in correct scale, covering equipment, showing arrangement of components and overall coordination.

b. In order to facilitate review of product data, they shall be clearly annotated, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where and/or what item(s) are used for and where item(s) occur in the contract documents. Identify product data as to the item and/or location (i.e. "surge suppression switchboard MDP").

c. See specific sections of the specifications for further requirements.

d. Re-Submit any technical data or shop drawing rejected by the Engineer of Record or the Department.

T740-7 Substitutions.

T740-7.1 Description.

General, administrative and procedural requirements for substitutions of products specified in the toll site electrical, communications, and safety and security infrastructure TSP sections including toll equipment building TSP subsections where applicable.

T740-7.1.1 Definitions.

Substitutions: Products, materials, equipment, finishes, and methods of construction are considered substitutions if they meet any one of the following conditions:

1. Is not the specified manufacturer and/or model.
2. Accomplishes the same result as the specified product / basis of design product but requires more space and / or power.
3. Requires changes in other elements of the work such as (but not limited to) architectural, mechanical, structural, or other electrical work.
4. Affects the project schedule or cost.

T740-7.1.2 Permitted Substitute Equipment or Products (with "or equal")

Substitutions are permitted for manufactured items or equipment identified by part numbers or catalog numbers items specifically identified with the tag "or equal". Substitutions must conform to the following:

1. Substituted item is equal or superior to specified product in all aspects.
2. Substitutions will be provided at no additional cost to the Department.
3. Warranties for the substitution must be equal to or greater than the warranties specified.
4. Submit shop drawings and applicable calculations for the substituted item and all system and layout impacts, to the Engineer of Record for review. The shop drawings and applicable calculations must be signed and sealed by the Specialty Engineer or the Contractor's Engineer of Record. Submit in accordance with the requirements of 5-1.4.1 through 5-1.4.3, as appropriate.
5. Provide substituted item, equipment, product etc. and all changes to product, design, layout including the effort required to develop shop drawings and calculations at no additional cost to the Department.
6. Warranties for the substitution must be equal to or better than the warranties specified.
7. Substitutions must have the same space/layout profile and must not require changes to other design systems and / or their functionality. When the substituted item does not meet this criterion, the substitution will need to conform to the additional requirements below.

T740-7.1.3 Permitted Substitute Equipment or Products (without "or equal")

Substitutes proposed for an item, equipment, product, etc. that has not been identified with a tag "or equal" must at a minimum conform to the following additional criteria:

1. Substituted item must be equal or superior to specified product in all aspects.
2. Provide analysis of systems and layouts that may be affected by the substitution. Provide shop drawings, manufacturer's catalog cuts and operating instructions,

calculations to demonstrate that the toll site and all associated systems continue to function at or a better level compared to the basis of design.

If a new request for substitution is submitted for an item that impacts previously approved requests for submission for any reason, the Department will require that the new and/or previously approved requests / documentation be re-submitted.

T740-7.2 Request for Substitution

T740-7.2.1 Representation: In submitting a substitute item, equipment, product, etc. that has not been listed on contract drawings, in contract documents or in an addendum, verify / perform the following:

1. Substituted item is equal or superior to specified product in all aspects.
2. Coordinate installation of accepted substitution into work, making changes as may be required to complete work in all aspects.
3. Waive all Claims for additional costs related to substitution which may subsequently become apparent.
4. Provide the same warranties for the substitution as for the product specified.
5. Absorb all costs incurred by the substitution when affecting other trades including but not limited to electrical, mechanical, structural, architectural, civil, etc.
6. Absorb any cost incurred by the Engineer in review of the substituted product if the acceptance of the substituted item creates the need for system modification and/or redesign, or if the substituting contractor exhibits negligence in his substituting procedure thus submitting inferior, misapplied or mis-sized equipment. In the event of additional engineering costs the billing structure shall be agreed upon prior to review by all involved parties.
7. Absorb any costs related to impacts to the project schedule or cost as a result of the use of the substituted item.

T740-7.2.2 Submittals: Submit separate requests for substitutions for each individual product, material, equipment, etc. that is defined as a substitution.

The submittal must consist of a dated written request for substitution as required below. The request must be very specific as to what specified item the request for substitution is submitted for.

Include the following in each request for substitution submittal:

1. Name of product, material, equipment, process etc. to be substituted.
2. Drawings, product data, calculations signed and sealed by a professional engineer licensed in the State of Florida, performance data and/or other information necessary for the Engineer to determine that the equipment meets all specifications and requirements.
3. Compliance statement. Each request for substitution shall include the following compliance statement typed on letterhead of submitting company:
   a. Submittal complies with all aspects/requirements of contract documents: (Yes/No) If No, state deviances.
   b. Submittal complies with all applicable codes: (Yes/No) If No, state deviances.
   c. Submittal does not require change to any other element of the work: (Yes/No) If No, state required change.

d. Meets or exceeds the performance of specified product: (Yes/No) If No, state required change.

e. Affects project schedule: (Yes/No) If Yes, quantify impact.

T740-7.3 Consideration and Acceptance

The Engineer's decision on acceptance or rejection of substitutions will be final.

Substitutions will be considered on basis of design, concept of work, and overall conformance with information given in Contract Documents, including but not limited to:

1. Design criteria, which shall be equal or superior to the specified item.
2. Finishes, which shall be identical or superior to finishes of specified product.
3. Lenses or louvers, which shall be identical size, thickness and type material specified.
4. Physical size and dimension which are identical or within design criteria limitations.
5. Photometric data, which shall be identical or superior in quantity and quality.
6. Trim detail, electrical, and mechanical qualities, shall be identical or within design criteria limitations as determined by the Engineer.

Approval of a substituted item or listing a substituted item as an approved substitution does not modify or act as a waiver in any way, of the requirements of the contract documents.

T740-8 Method of Measurement.

The work specified in this section will not be measured separately and will be included in the pay items for the OCC, Panelboards and Generator at RTC Sites for each pay item's associated electrical work.

T740-9 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES FOR RTC SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T741A
LOW VOLTAGE ELECTRICAL POWER CONDUCTORS
AND CABLES FOR RTC SITES

T741A-1 Description.

Furnish and install electrical power conductors (wire), cable, wiring connectors, and connections, as shown in the Plans.

T741A-2 Coordination.

Schedule and arrange electrical work in a neat, well-organized manner without interference with the work scheduling of other trades.

1. Coordinate Work with other trades.
2. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.
3. Determine required separation between cable and other work.
4. Determine cable routing to avoid interference with other work.

T741A-3 Materials.

T741A-3.1 Toll Site Project Conditions

Conductor sizes on the Plans are based on copper.

Electrical power conductors 10 AWG and smaller may be spliced in order to construct longer circuits. Electrical power conductors 8 AWG and larger may not be spliced.

The current carrying capacity of electrical power conductors shall be determined using the tables in NEC Article 310. Calculating the current carrying capacity of conductors by assuming a lower ambient temperature than the one shown in the header of the Ampacity table(s) in Article 310 is not permissible, unless the lower ambient temperature is written and described in the Contract Documents.

Aluminum wiring is not permitted.

Ensure all sizes are given in American Wire Gauge (AWG) or in thousand circular mils (kcmil).

Conductors shall be marked with color codes as described in this Section.

T741A-3.2 Conductors

Install THHN/THWN insulated copper conductors rated for 600 Volts, with PVC insulation, and a nylon thermoplastic outer jacket. Ensure the solid or stranded conductors are made of annealed copper and rated for 90°C in dry locations, and 75°C for wet or below grade locations. Ensure the conductors are UL 83 Listed and are suitable for use in residential, commercial, and industrial environments. All systems and low voltage conductors shall be stranded conductors.

Install XHHW or XHHW-2 insulated copper conductors rated 600 Volts, with XLPE insulation to protect the conductor against high temperatures and wet locations. Ensure the solid or stranded conductors are made of annealed copper and rated for 90°C in dry locations, and

75°C for wet or below grade locations. Ensure the conductors are UL 44 Listed and are suitable for use in residential, commercial, and industrial environments.

Type TC Multiconductor Power and Control Tray Cable.

a. The individual conductors shall be stranded copper with XHHW-2 insulation.

b. The overall cable jacket will consist of a flame retardant, moisture resistant, and sunlight resistant PVC covering.

c. The cable shall be listed for installation indoors, outdoors, in cable trays, raceways, and for direct burial in the ground.

d. Type TC cable may be installed as open wiring in lengths not to exceed fifty feet between the cable tray and the device or equipment served. Open wiring shall be secured and supported at intervals less than six feet.

e. Type TC Cables with three individual conductors sized between 12 AWG and 10 AWG shall be constructed with a green colored grounding conductor, a white neutral conductor, and a black phase conductor.

f. Type TC Cables with four individual conductors sized between 12 AWG and 10 AWG shall be constructed with a green colored grounding conductor, a white neutral conductor, a black phase conductor, and a red phase conductor.

T741A-3.3 Wiring Connectors

Install fully insulated mechanical connectors, UL 486B Listed, and rated for 600 Volts maximum for 8 AWG and larger conductors in dry locations.

Install PVC insulated spring pressure cable connectors (wire nuts), UL 486C Listed, and rated 600 Volts maximum for 10 AWG and smaller conductors in dry locations.

Electrical conductor splices and/or taps below grade level are not acceptable for non-emergencies. For emergency conductor repairs below grade, install wrap-around UF splice kits with splice closure sleeves filled with sealing gel that entirely encapsulates the mechanical connector to seal out moisture. The underground splice kit shall be qualified to ANSI C119.1 for underground splicing and shall be rated for use on 600 Volt connections.

Communications cables, coaxial cables, and Ethernet cables shall be installed in continuous lengths and shall not be spliced in the field.

T741A-4 Submittals.

Meet the requirements of Sections 5 for any required submittals. Provide submittals to the Engineer for review by the Department in accordance with Section 5 and the Contract Documents.

Submit data sheets and catalog sheets describing each type of conductor, connector, splicing material, and terminal lug that will be installed on the project.

Include descriptive names for the conductors that indicate the system or equipment they serve. i.e. “generator feeders”, “service entrance conductors”.

T741A-5 Qualifications.

Manufacturer must specialize in manufacturing products specified in this Section with minimum five years’ experience.

T741A-6 Construction Requirements.

T741A-6.1 Examination:

Examine the Contract Documents and the site of the proposed work carefully before starting work.

Verify that interior of any cabinets are protected from weather.

Verify that mechanical work likely to damage wire and cable has been completed.

Verify that raceway installation is complete and supported.

Before installing raceways and pulling wire to any mechanical equipment, verify electrical characteristics with final approved submittal for equipment to assure proper number and size of the conductors. (As for multiple speed motors, different motor starter arrangements, etc.).

T741A-6.2 Preparation:

Completely and thoroughly swab raceway before installing wire.

T741A-6.3 General:

Install products in accordance with manufacturer's instructions.

Route wire and cable as required to meet the Project Conditions.

Install cable in accordance with the NECA "Standard of Installation".

Use solid conductor wire for feeders and branch circuits 10 AWG and smaller and use stranded conductors for #8 AWG and larger. Bonding grounding conductor can be solid copper. All systems and low voltage conductors shall be stranded conductors.

Use conductors 12 AWG or larger for power and lighting circuits.

Increase branch conductor sizes as required to maintain a branch circuit voltage drop of less than 3% to the load served when the branch circuit is operating at full rated load.

Ensure all 120V, 20A circuit homeruns over 50ft. are #10 cu. minimum unless noted otherwise.

Ensure all 120V, 20A circuit homeruns over 150ft. are #8 cu. minimum, unless noted otherwise.

Pull all conductors into the raceway at the same time. Do not exceed the manufacturer’s recommended pulling tensions.

a. Do not pull wire until the conduit system is complete from pull point to pull point and major equipment terminating conduits have been fixed in position.

b. Ensure the minimum bending radius of insulated wires or cables is not less than the minimum recommended by the manufacturer or the NEC.

c. Where coaxial or fiber optic conductors are installed, special requirements apply as outlined under that specific system detail specifications.

Use suitable wire pulling lubricant for wire. Ensure compound or lubricant does not cause the conductor or insulation to deteriorate.

Neatly train and lace wiring inside boxes, equipment, and panel boards.

Ensure conductor sizes indicated on circuit homeruns or in schedules are installed over the entire length of the circuit unless noted otherwise on the drawings or in these specifications.

T741A-6.4 Vertical Risers:

Provide vertical cable riser supports that are spaced per NEC 300.

T741A-6.5 Control and Signal Circuits:

1. For control and signal circuits above 50 VAC, conductors shall be #14 AWG minimum size, THWN/THHN.

2. For control and signal circuits 50 VAC and below, conductors, at the Contractor's option, may be #16 AWG, 300 volt rated, PVC insulated, except where specifically noted otherwise in the contract documents.

3. All control and signal circuit conductors shall be stranded copper conductors.

T741A-6.6 Taps/Splices/Connectors/Terminations:

1. Clean conductor surfaces before installing lugs and connectors.

2. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3. Conductors shall be continuous and unspliced where located within conduit. Splices shall occur within troughs, wire ways, junction boxes, outlet boxes, or equipment enclosures where sufficient additional room is provided for all splices. No splices shall be made in in-ground pull boxes (without written approval of engineer).

4. Allow adequate conductor lengths in all junction boxes, pull boxes and terminal cabinets. All termination of conductors in which conductor is in tension will be rejected and shall be replaced with conductors of adequate length. This requirement shall include the providing by the Contractor of sleeve type vertical cable supports in vertical raceway installations provided in pull boxes at proper vertical spacing.

5. A calibrated torque wrench shall be used for all bolt tightening.

6. Clean conductor surfaces with a wire brush before installing lugs and connectors.

7. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

T741A-6.7 Field Quality Control:

1. Perform inspections and tests listed in the NETA ATS, Section 7.3

2. Perform an Insulation Resistance test – documenting the results using the Conductor Insulation Resistance template on all power system conductors larger than 10 AWG. Turn over written test results to the CEI within 48 hours of completing the test. Turn over written test results to the CEI within 48 hours of completing the test. A copy of the Conductor Insulation Resistance template may be obtained from the Engineer at the pre-construction conference

T741A-7 Color Coding.

All feeders and branch circuits No. 6 and smaller shall be wired with color-coded wire with the same color used for the system throughout the toll site. Feeders above No. 6 shall either be fully color-coded or shall have black insulation and be similarly color-coded with tape or paint in all junction boxes and panels. Tape or paint shall completely cover the full length of conductor insulation within the box or panel.

Unless otherwise approved, or to match the existing, the color-codes must be as follows:

T741A-7.1 Utility or Generator Power:

120/240 Volt, 1 phase, 3 wire

a. Line 1 = black
b. Line 2 = red
c. Neutral = white
d. Equip Ground = green

T741A-7.2 UPS Power / Clean Power:

120/240 Volt, 1 phase, 3 wire

a. Line 1 = black
b. Line 2 = red
c. Neutral = white with yellow stripe
d. Equip ground = green with yellow stripe

T741A-8 Method of Measurement.

The quantity to be paid for will be the plan quantity of each conductor and cable, in feet, completed and accepted. Measurement will be based on the overall length of each conductor between pull boxes, equipment, equipment cabinets, and terminal devices. Add 10 feet of slack for each pull point and terminal device.

Do not include length of conductors or cables on the toll gantry; they are incidental to the gantry.

Do not include length of conductors or cables inside toll site cabinets; they are incidental to those items.

T741A-9 Basis of Payment.

Prices and payments will be full compensation for all work specified in this Section, including all materials, equipment and tests.

Payment will be made under:

Item No. 639-7-114 Electrical Power Service, Toll Facility Conductors and Cables, No. 10 And Smaller	LF
Item No. 639-7-115 Electrical Power Service, Toll Facility Conductors and Cables, No. 8 to No. 6	LF
Item No. 639-7-116 Electrical Power Service, Toll Facility Conductors and Cables, No. 4 to No. 2	LF
Item No. 639-7-117 Electrical Power Service, Toll Facility Conductors and Cables, No. 1 to No. 1/0	LF
Item No. 639-7-118 Electrical Power Service, Toll Facility Conductors and Cables, No. 2/0 to No. 3/0	LF
Item No. 639-7-121 Electrical Power Service, Toll Facility Conductors and Cables, 350KCMIL to 400 KCMIL	LF

TECHNICAL SPECIAL PROVISION

FOR

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T741B
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS AT RTC TOLL SITES

T741B-1 Description

Furnish and install Grounding and Bonding for Electrical Systems at RTC Toll Sites in accordance with the details shown in in the Plans. Furnish all labor, materials, services, testing, and equipment necessary to provide and install Grounding and Bonding for Electrical Systems at each toll site including the following elements:

1. Grounding electrodes and grounding electrode conductors.
2. Inspection wells.
3. Equipment grounding conductors.

T741B-2 Materials.

T741B-1.1. Grounding System Description

1. Bond together the following items to form the grounding system for the power distribution system.

a.

b. Concrete-encased electrode consisting of 20 feet of #4 AWG copper minimum size, bare copper conductor imbedded in a building footer or equipment slab and terminated at the neutral bar at the first service disconnecting means. Ensure this grounding electrode conductor is continuous and not spliced.

c. A continuous and un-spliced main bonding jumper shall connect the equipment ground bar and the metal service entrance disconnect enclosure to the neutral bus bar.

d. Rod electrodes – Copper clad steel rods, 5/8-inch diameter, and UL Listed. A minimum of two rods are required for each electrical service.

e. Couplings or connectors used to join multiple ground rods together shall be of the threaded type.

f. The lightning protection system ground ring in accordance with NFPA 780.

T741B-1.2. Rod Electrodes

1. Material: Copper-clad steel, sectional with threaded couplings
2. Diameter: 5/8 inch
3. Length: 20 feet total length

T741B-1.3. Exothermic Connections

Use exothermic welding to bond the grounding electrode conductors to the ground rods.

T741B-1.4. Grounding Conductors

1. Material: Stranded or solid copper
2. Grounding Electrode Conductor: Sized to meet NFPA 70 requirements.

T741B-1.5. Grounding Inspection Wells

1. Within non-paved areas, install non-traffic rated ground rod access wells that are manufactured from 20,000 PSI high density polymer concrete and meet ASTM C-857

specifications with a minimum size of 12” x 12” x 12”. Install a high-density polymer concrete cover for each access well.

2. Install traffic rated ground access wells in paved areas and on roads or shoulders. The access wells shall be traffic rated H-20 with 10 inch diameter cast iron top and cast iron cover, with 12 inch minimum cast iron riser.

T741B-1.6. Performance Requirements

1. Grounding Rod Resistance: Use the fall of potential three-point method and test each ground rod individually before connecting it to the system. Ensure the maximum resistance to ground (earth) does not exceed 25 Ohms. If a ground rod measures greater than 25 Ohms to ground then a second ground rod should be installed nearby, but not closer than the depth of the 1st rod, and then bond the two rods together with a direct buried conductor. Turn over the test reports to the Engineer within 1 week of performing the test.

2. The resistance to ground should be consistent between the ground rods. Any rod that measures more than 20% different than the surrounding rods should be investigated.

3. After bonding all the power system grounding components together, use the “Clamp on Method” to measure the resistance to ground of the completed system. Ensure the maximum resistance to ground (earth) does not exceed 5 Ohms. Drive additional ground rods if necessary to meet the requirements. Promptly turn over the test reports to the Engineer.

T741B-2 Submittals

1. Product Data: Submit data sheets for all grounding electrodes, clamps, bonding straps, ground bars, exothermic welding products, and inspection wells.

2. Submit a site specific One-Line Grounding Plan that indicates all grounding electrode conductor connection points and grounding conductor sizes at the service disconnect, automatic transfer switch (ATS), back-up generator, and the uninterruptable power supply (UPS) when depicted on the Toll Facility component plans.

3. Show the locations of the grounding system inspection wells on the Electrical Site Plan. Inspection wells in paved areas will be “traffic rated” H-20.

T741B-3 Qualifications

1. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years of experience.

T741B-4 Construction Requirements

T741B-4.1. Examination

1. Verify existing conditions prior to beginning the work.

2. Verify that final backfill and compaction has been completed before driving rod electrodes.

T741B-4.2. Installation

1. Install rod electrodes at locations indicated on the plans. The service entrance ground rod electrodes shall consist of two 20 ft driven rods spaced 20 feet apart or more.

2. Provide a grounding inspection well at each driven rod location in the power distribution system (not for lightning protection system). The top of the inspection well will be flush with the finished grade.

3. A main bonding jumper shall connect the neutral bus to the ground bus at the first service disconnect.

4. The main grounding electrode conductor shall be installed in one continuous length and shall not be spliced or broken at any point until it terminates at the neutral bus within the first service disconnecting means.

5. Provide bonding to meet NFPA 70 and Regulatory Requirements (i.e., metal duct work, metal piping, gas piping etc.).

6. Bond together metal siding not attached to a grounded structure and bond to ground.

7. Equipment Grounding Conductor: Provide a separate, green, insulated conductor within each feeder and branch circuit raceway. Terminate each end on a suitable lug, bus, or bushing.

T741B-4.3. Field Quality Control

Measure the continuity of each grounding electrode conductor after it is installed and prior to connecting it to the system. The maximum acceptable continuity resistance is 0.02 Ohms.

T741B-5 Method of Measurement

The work specified in this section will not be measured separately and will be included in the pay items for the Toll Gantry, OCC, Panelboards and Generator at RTC Sites for the associated grounding and bonding each pay item's electrical system.

T741B-6 Basis of Payment

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS AT RTC SITES

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SECTION T741C
HANGERS AND SUPPORTS FOR
ELECTRICAL SYSTEMS AT RTC SITES

T741C-1 Description.

Furnish of all labor, materials, services, testing, and equipment necessary to provide and install hangers and supports for electrical systems at each toll site including the following:

1. Hardware for the support of conduit, tubing, and cable
2. Wireway supports and wire trough supports
3. Anchors and fasteners

T741C-2 Materials.

1. Materials and Finishes: Provide products with adequate corrosion resistance based on the environment where the products are installed. All steel products must be hot-dipped galvanized except for stainless steel products.

2. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of the supported equipment and the conduit. Consider the weight of the wires in the conduit when selecting products.

T741C-2.1. Regulatory Requirements:

1. Conform to requirements of NFPA 70, the National Electrical Code.

2. Furnish products listed and classified by Underwriters Laboratories, Inc. and acceptable to the Department as suitable for purpose specified and shown.

3. ASTM A123 - Specifications for Zinc Coatings on Iron and Steel products.

T741C-2.2. Anchors and Fasteners:

1. Concrete surfaces and structural elements: Use expansion anchors, preset inserts, and self-drilling anchors.

2. Steel Structural Elements: Use beam clamps that will not damage the protective zinc coating of galvanized steel.

3. Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.

4. Solid Masonry Walls: Use expansion anchors, preset inserts, and self-drilling anchors.

5. Sheet Metal: Use galvanized sheet metal screws.

6. Wood Elements: Use galvanized wood screws.

T741C-2.3. Steel Strut Channel:

1. The cross-sectional width dimension of the steel strut channel (channel) must be a minimum of 1-1/2”. The depth will be as required to satisfy the load requirements. Channel with 1-1/2” depth or greater must be rolled from 12-gauge steel.

2. Attachment holes, when required, must be factory punched on hole centers equal to the channel cross sectional width dimension and must be a maximum of 9/16" diameter.

3. Channel attachment nuts must be designed to pre-locate in the strut channel and provide a bearing surface on the turned down lips while making positive contact with the side walls of the channel.

4. Steel channel sections must be rolled from AISI C1018 commercial grade steel and be in conformance with ASTM A569.

5. Stainless steel channel sections must be available in either 304 or 316 stainless steel.

6. Steel channel used for modular metal framing and conduit supports must be in compliance with the Federal Specification W-C-582 and Federal Specification WW-H-171.

7. Install steel strut channel in straight sections only and do not be bent in the field.

8. Install hot dipped galvanized after fabrication channel or stainless steel channel for exterior applications. Install painted steel or hot dipped galvanized channel for indoor applications. Steel channel that is hot dipped galvanized after fabrication must have a minimum Zinc thickness of 1.5 ounces per square foot on each surface according to ASTM A123 - Specifications for Zinc Coatings on Iron and Steel products.

9. Install bolt nut and washer assemblies in accordance 460-5.

10. Repair damaged zinc finish on field cut and field drilled galvanized steel strut channel by using cold galvanizing methods. The cold galvanizing compound must be pre-mixed and composed of a liquid organic zinc compound. After application, the dried zinc compound film must be 95% metallic zinc.

11. Provide protective end caps on channel ends. The protective caps must be made of soft PVC and manufactured by the same company that manufactured the channel.

T741C-2.4. Conduit Supports and Fasteners:

1. Support conduit securely and fasten to the structure it is installed upon. The conduit mounting hardware must be manufactured by the same company that manufactured the channel for the environment they were designed.

a. Hangers, clamps, straps, and hardware for supporting conduit must be listed in accordance with UL 2239 – Hardware for the Support of Conduit Tubing, and Cable by UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.

b. Hardware for supporting boxes must be UL 514A listed by UL or other NRTL.

c. Cable ties or Ty-wraps must not be used to support conduit or junction boxes.

2. Conduit supports and support fasteners and bolts used outdoors or in wet locations must be manufactured from carbon steel and must be hot dipped galvanized after fabrication and according to ASTM A123.

T741C-3 Shop Drawings and Submittals.

Provide catalog sheets showing fastening details as applicable.

Provide steel strut channel product data including strut channel frame support material, attachment details for attaching to the concrete pad and attachment details for attaching equipment to the strut channel frame.

Provide mounting details for raceways and boxes, fire extinguisher cabinets and accessories mounted to the frames.

Provide manufacturer's installation instructions including application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

Submit strut channel frame support material certifications and scaled drawings ½" = 1' showing the support frame design.

T741C-4 Construction Requirements.

T741C-4.1. Installation:

1. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

2. Do not use powder-actuated anchors to secure electrical equipment.

3. Obtain permission from Engineer before drilling or cutting structural members or galvanized metal.

4. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

5. Install Power Distribution Frame and E6 Mounting Frame in accordance with the following:

a. Attachment holes, when required, must be factory punched on hole centers equal to the channel cross sectional width dimension and must be a maximum of 9/16" diameter.

b. Channel attachment nuts must be designed to pre-locate in the channel and provide a bearing surface on the turned down lips while making positive contact with the side walls of the channel.

c. Steel channel must be installed in straight sections only and must not be bent in the field.

d. Install protective end caps on channel ends.

6. Install surface-mounted cabinets and panelboards with minimum of four anchors.

7. Threaded rod hangers must be galvanized continuous thread type, minimum 3/8" diameter. Increase size as required to support assembly. Bending of rod hangars is not permitted.

8. Conduit support racks must be minimum of 24", increase, distance as required for quantity of conduits and spare capacity) provide space on each rack for 25 percent additional

conduits. Group conduits on channel racking adjacent to each other at sides, allowing all remaining unused space at center as spare capacity. Do not exceed 1" spacing between conduits.

9. In general conduit supporting devices such as spring type conduit clips are not acceptable. Conduit clips with snap close strap are acceptable for use in dry interior concealed locations only. Back-to-back arrangement or attachment to other raceways, piping, etc. is not permitted.

10. All hangers, clips and accessories for supporting must be listed by UL or other NRTL.

11. Support systems must meet requirements for seismic loads. Refer to general Conditions of the specifications.

12. Support conductors not in raceways directly from the structure with devices listed by UL or other NRTL as intended for such use. Cable ties used with listed support devices within plenum air environments must be plenum rated by UL or other NRTL.

T741C-5 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

IDENTIFICATION FOR ELECTRICAL SYSTEMS AT RTC SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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City, State, Zip Code: _____

SECTION T741D
IDENTIFICATION FOR ELECTRICAL SYSTEMS AT RTC SITES

T741D-1 Low Voltage Electrical Power Conductors and Cables

Furnish of all labor, materials, services, testing, and equipment necessary to provide and install identification for electrical systems including, nameplates and labels, wire and cable markers, and conduit markers.

T741D-1 Materials.:

T741D-1.1. Regulatory Requirements

1. Conform to requirements of ANSI/NFPA 70.

2. Furnish products listed and classified by Underwriters Laboratories, Inc., and acceptable to authority having jurisdiction as suitable for purpose specified and shown.

T741D-1.2. Nameplates:

Equip the following items with nameplates: Wire troughs, and conduits at the base of the gantry. All motors, motor starters, push button stations, control panels, time switches, disconnect switches, transformers, panelboards, all circuit breakers in panelboards greater than 400 Amps, contactors or relays in separate enclosures, power receptacles where the nominal voltage between any pair of contacts is greater than 150V, wall switches controlling outlets that are not located within sight of the controlling switch, high voltage boxes and cabinets, large electrical systems junction and pull boxes (larger than 4 11/16”), terminal cabinets, terminal boards, and equipment racks. Describe the associated panel and circuit number on the nameplate.

Provide nameplates for all equipment in accordance with the following:

1. Nameplates for normal power: Laminated phenolic plastic, chamfer edges, red (and black version) front white core, with lettering etched through the outer covering. White engraved letters on red (and black version) background.

2. Nameplates for emergency power (where applicable): Laminated phenolic plastic. Red front, with white core, with lettering etched through outer covering, white engraved letters on red background.

3. Letter Size:

   a. Use 1/4-inch-high letters for identifying individual equipment and loads.
   b. Use 1/2-inch-high letters for identifying grouped equipment and loads.
   c. Use 1-inch-high letters for identifying Service Disconnecting means.

4. Provide nameplates that adequately describe the function of the particular equipment involved. Where nameplates are detailed on the drawings, inscription and size of letters shall be as shown and shop drawing submitted for approval. Nameplates for panelboards must include the panel designation, voltage and phase of the supply. For example, “Panel A, 120/208V, 3-phase, 4-wire”. In addition, provide phenolic label in panel to describe where the panel is fed from. For example, “Fed from MDP-1:3:5”. The name of the machine on the

nameplates for a particular machine shall be the same as the names used on all motor starters, and disconnect switches for that machine.

5. Field install Arc Flash and Shock Warning labels on each piece of new electrical distribution equipment such as panelboards, safety switches, and automatic transfer switches. The labels will indicate the flash hazard boundary, the flash hazard at 18 inches, the PPE level requirements, and the approach restrictions.

6. Provide adhesion labels on inside door of each fused switch indicating NEMA fuse classification and the size fuse installed. .

T741D-1.3. Wire Markers:

Furnish and install wire markers for each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection. Wire markers shall be in accordance with the following:

1. Cloth, tape, split sleeve, or tubing type wire markers.

2. Legend.

a. Power and Lighting Circuits at both ends of each conductor. Branch circuit numbers or feeder numbers as indicated on the construction plans. Including the neutral conductor. i.e. the conductor connected to circuit breaker #2 will be labeled with a wire marker showing "2". The neutral associated with this circuit will also be labeled with a wire marker showing "2".

b. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on shop drawings.

T741D-1.4. Conduit/Junction Box Color Code:

Color code all conduit system junction boxes (except those subject to view in public areas) as listed below:

Table 1 Color Code Requirements

Color Code for Junction Boxes	Krylon Paint #
System Emergency 120/208 volt	Light Red 2110
Fire Alarm	Popsicle Orange 2410
Normal Power 120/240 volt	Glossy Black 1601
Fiber Optics	Plum Purple 1929
Sound System	Daisy Yellow 1813
Intercom	True Blue 1910
Computer/Data	Gold 1701
BAS	Light Beige 2502
FIDS / BIDS	Beige 2504
Security/CCTV	Moss Green 2004

Color Code for Junction Boxes	Krylon Paint #
Telephone	Light Green 2011
Grounding	Fluorescent Green 3106

Paint conduits (not subject to public view) longer than 20 feet with the color paint band identified in the table above, 20 ft. on center as follows:

1. Paint band shall be 4" in length.
2. Evenly align paint bands where conduit is parallel and on conduit racking.
3. Apply paint neatly and uniformly.
4. Paint boxes and raceways prior to installation or tape conduits and surrounding surfaces to avoid overspray. Paint overspray shall be removed.
5. Junction boxes and conduit located in public areas (i.e. areas that can be seen by the public) shall be painted to match the surface they are installed upon.

T741D-1.5. Conduit/Junction Box Color Code:

Provide markers/markings for all new and existing junction boxes/cover plates for power, lighting and systems (except those installed in public areas) as listed below:

1. Use black permanent marker for identification.

2. Paint half of the cover plate with appropriate color as noted in **Table 1**, and mark the other half with the associated panel/circuit or system description as identified below.

3. Adequately describe the conduit's / junction box's associated panel and circuit reference number(s) (i.e. ELRW-2, 4, 6) or systems (i.e. fire alarm, SCADA, etc.).

Identify conduit not installed in public areas with circuit numbers as noted in **Table 1**. Provide spacing of 20 feet on center, adjacent to color identification bands.

T741D-1.6. Device Cover Plate Identification:

Provide self-adhesive clear printed labels with Black typed letters (pre-printed, dot matrix, or laser) at the locations identified below. Labels printed with Ink Jet printers are not acceptable.

1. Each new switch and receptacle cover plate.

2. Each existing switch and receptacle cover plate in areas of remodel/renovation.

3. Each new communications cover plate.

4. Each existing communications cover plate in areas of remodel/renovation.

Adequately describe receptacle plates with its associated panelboard and circuit reference (i.e., L1A-3).

Adequately describe system plates with its associated terminal board, or terminal cabinet, termination cable identifier, and assigned user code number, (i.e., TTB-LS2-***).

T741D-1.7. Underground Warning Tape:

Install 4-inch-wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines

T741D-1.8. Signage:

Provide laminated phenolic plastic signage as follows:

1. Chamfer edge, white core, face color as specified in **Table 1**
2. Lettering must be etched through the outer covering
3. Lettering size: 1" lettering
4. Locations:
    a. More than one service per NEC (if applicable)
    b. b. Emergency Generator Systems per NEC (if applicable)

T741D-2 Shop Drawings and Submittals.

1. Submit data sheets and catalog sheets for each label and marker.
2. Indicate application conditions and limitations of use stipulated by Product testing agency specified under regulatory requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

T741D-3 Construction Requirements.

T741D-3.1. Preparation:

Degrease and clean surfaces to receive nameplates.

T741D-3.2. Application:

1. Install nameplate parallel to equipment lines.
2. Secure nameplate to equipment front using stainless steel pop rivets.
3. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
4. Paint colored band on each conduit longer than 6 feet (2 m).
5. Identify underground conduits using underground warning tape. Install one tape per trench at 3 inches below finished grade.
6. Identify junction boxes and outlet boxes.
7. Nameplates installed inside on dead front cover shall be self-adhesive tape. (Do not drill or install screws in dead front covers unless prior approval is granted by equipment manufacturer).
8. Exterior nameplates installed on wire troughs and all outdoor electrical equipment must be provided with an epoxy-based adhesive.
9. Install wire markers at all connections and terminations.

T741D-3.3. Method of Measurement.

Identification of electrical systems will not be measured separately and is included in the pay items for the OCC, Panelboards and Generator along with conductors and cabling associated with the electrical equipment.

T741D-3.4. Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

LIGHTNING PROTECTION AT RTC SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T741E
LIGHTNING PROTECTION AT RTC SITES

T741E-1 Description

Provide a Class I lightning protection system to protect the toll equipment gantry(ies), the fuel tank, generator set, outdoor metal enclosures, outdoor equipment racks and any outdoor equipment that extends higher than 10 feet above grade level.
Provide a Class I lightning protection system as described in NFPA 780, LPI 175, UL 96A, NEC, and the Plans and Specifications to protect toll equipment building (TEB), the toll equipment gantry(ies), the fuel tank, generator set, outdoor metal enclosures, outdoor equipment racks and any outdoor equipment that extends higher than 10 feet above grade level.

T741E-2 Materials.

T741AE-2.1. Regulatory Requirements

1. Conform to requirements of NFPA 780, LPI 175 and NEC.

2. Furnish products listed and classified by Underwriters Laboratories, Inc. UL 96A, and acceptable to authority having jurisdiction as suitable for purpose specified and shown.

T741AE-2.2. Conductors

1. Grounding ring electrode conductors and underground conductors must be copper and the minimum acceptable size is 98,600 circular mils, with 24 strands.

2. Down conductors must be copper.

3. Air Terminals: Aluminum or copper with a threaded 5/8-inch diameter base and pointed at the tip. Air terminals will be solid and not hollow.

T741AE-2.3. Fasteners

Conductor fasteners must be of the same material as the conductor, having ample strength to support conductor.

T741AE-2.4. Ground Rods

Lightning protection system ground rods will be sectional, 5/8" diameter, copper clad steel ground rods. The copper cladding must be a minimum of 0.010 inch thick.

T741E-3 Submittals and Shop Drawings.

1. Submit shop drawings for review before site work begins. Include drawings of the entire site that shows the location of all site components and interconnections between each component and each piece of equipment bonded to the system. Include locations of air terminals, cabling, ground rings, ground rods, down conductors.

2. Submit product data sheets on cabling, ground rings, ground rods, down conductors, fasteners, cable connectors and exothermic welding products.

T741E-4 Qualifications

Submit written evidence showing manufacturer and installer's qualification to the Department prior to beginning work.

2. Manufacturers: Firms regularly engaged in manufacture of lightning protection systems, whose products have been in satisfactory use in similar service for not less than 5 years.

3. Installer: Firms holding an EC License in the State of Florida with at least five (5) years of successful installation experience on projects with electrical installation work similar to that required for the project.

T741E-5 Construction Requirements.

Only experienced installers familiar with requirements of NFPA 780, the Lightning Protection Institute Standard of Practice 175, and Underwriters' Laboratories are permitted to install the lightning protection system.

1. This work includes all equipment to protect the toll site against damage by lightning whether or not specifically called for herein.

2. Install a 98,600 circular mil, 24 strand, bare copper lightning protection grounding electrode conductor around each toll structure extending out to each piece of equipment on the site. Install the conductor in direct contact with the earth and a minimum of 30 inches below grade.

3. Ground each metal support column on toll equipment structures (i.e. gantries) at two separate points near the base of the columns. Each grounding point must have a grounding pad and a separate down conductor and separate ground rod. The ground rods must be bonded together below grade.

4. The grounding lugs at the base of the gantry columns must be installed by the gantry fabricator. Field welding to galvanized metal gantries is not acceptable.

5. The ground rods will extend into the earth vertically not less than 20 feet.

6. Install in an inconspicuous manner with conductors coursed to be concealed as much as possible.

7. All metallic equipment within 6 feet of any lightning conductor shall be bonded to conductor.

8. Install lightning protection conductors that require physical protection in schedule 80 PVC conduit.

9. The following lightning protection systems at each site will be bonded together by a 98,600 circular mil, 24 strand, direct buried copper conductor.

a. Toll gantry columns
b. Emergency generator, enclosure, and fuel tank with any metal piping
c. Metal enclosures and wireways

10. The completed system will be inspected by an independent 3rd party and must receive a UL Master Label or The Lightning Protection Institute Inspection Program (LPI-IP) Certificate.

T741AE-5.1. Conductor Connections and Splices

1. Connections above grade level will be made with mechanically bolted fittings of aluminum, copper, or tin-plated bronze.

2. Connections below grade will be made by welding.

T741AE-5.2. Testing

1. Use the fall of potential three-point method and test each ground rod individually before connecting it to the system. Ensure the maximum resistance to ground (earth) does not exceed 25 Ohms. If a ground rod measures greater than 25 Ohms to ground then a second ground rod should be installed nearby, but not closer than the depth of the 1st rod, and then bond the two rods together with a direct buried conductor. Turn over the test reports to the Engineer within 1 week of performing the test.

2. The resistance to ground should be consistent between the ground rods. Any rod that measures more than 20% different than the surrounding rods should be investigated.

3. After bonding all the lightning protection system ground rods together and connecting the ground rings, use the “Clamp on Method” to measure the resistance to ground of the completed lightning protection ground rod system. Ensure the maximum resistance to ground (earth) does not exceed 5 Ohms. Drive additional ground rods if necessary to obtain a resistance to ground reading of 5 Ohms or less. Turn over the test reports to the Department within 1 week of performing the test.

T741E-6 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

ELECTRICITY METERING AND UTILITY SERVICE ENTRANCE AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T742A
ELECTRICITY METERING AND UTILITY SERVICE ENTRANCE
AT RTC TOLL SITES

T742A-1 Description.

Furnish all labor, materials, services, testing, and equipment necessary to provide and install Electric Metering and Utility Service Entrance Equipment at each RTC Toll Site which includes:

1. Service racks
2. Metering transformer cabinets
3. Meter bases

T742A-2 Materials.

742A-2.1 Standards:

Electric Metering and Utility Service Entrance Equipment must meet the following:

1. NECA Standard of Installation (National Electrical Contractors Association)
2. NFPA 70 - National Electrical Code
3. Listed and classified by Underwriters Laboratories, Inc. and acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

742A-2.2 System:

240/120 Volts, 200 Amp, 1 phase, 3 wire, 60 Hertz, with grounded neutral, or as shown on the plans.

742A-2.3 Meter Bases:

Furnish meter bases as follows:

1. Meter bases shall be fabricated from aluminum and then painted by the manufacturer.
2. The meter base shall contain in integral bypass that allows the meter to be removed and replaced without interrupting power to the building.
3. Neutral lugs must be sized to accommodate grounding conductors.

742A-2.4 Pad for Utility Transformer:

Furnish and install the utility transformer pad sized and configured as required by the Utility.

742A-2.5 Secondary Connection Cabinet:

If the quantity of underground service entrance conductors is greater than the utility pad mounted transformer lugs can accept, provide a secondary connection cabinet installed by the Electrical Contractor between the utility transformer and the service entrance point on the building.

Ensure the customer's service entrance conductors and the utilities service entrance conductors are properly joined inside this enclosure. Contact the utility company for

the specifications and requirements of this cabinet.

742A-2.6 Service Disconnect:

The service disconnect must comply with the following:

1. Vertically mounted main circuit breaker within an ATS, panelboard or as depicted in the plans.

2. Fuses must not be used as overcurrent protection for the power distribution system.

3. Contain a set of auxiliary contacts. The contacts will be open when the service disconnect is open and closed when the service disconnect is closed.

4. The service entrance feeder conduits must utilize rigid metal conduit elbows coated with PVC or Bitumen.

T742A-3 Quality.

Perform Work in accordance with Utility Company written requirements. Maintain one copy of each document on site.

T742A-4 Submittals and Shop Drawings.

Submit shop drawings in accordance with Section 5, and General Requirements for Toll Site Electrical Infrastructure.

Provide ratings and dimensions of transformer cabinets and meter bases. Include the Utility contact information, the electric meter base configuration and the utility transformer pad details in the engineering submittals.

T742A-5 Construction Requirements.

742A-5.1 Pre-Installation Meeting:

A pre-installation meeting must be scheduled with the Engineer and the Utility Company representative.

Review service entrance requirements and details with Utility Company representative at the pre-installation meeting.

742A-5.2 Field Measurements:

Verify that field measurements are as indicated on Utility Company drawings.

742A-5.3 Installation:

Install transformer pad, metering transformer cabinets, and meter base as required by the local Utility Company.

Service entrance conductors between the utility transformer and the toll facility must be continuous and must not be spliced or tapped.

Toll sites must have dedicated secondaries from the utility transformer to the utility power meter and must not be shared with non-tolling electrical loads.

T742A-6 Method of Measurement.

The quantity paid will be the plan quantity for Electric Metering and Utility Service Entrance furnished, installed, and accepted at each toll facility.

T742A-7 Basis of Payment.

Price and payment will be full compensation for all work specified in this Subsection.

Payment will be made under:

Item No. 639-7-122 Electrical Power Service,
Toll Site Electric Metering and Utility Service Entrance ..... Each

TECHNICAL SPECIAL PROVISION

FOR

PANELBOARDSAT RTC TOLL SITES

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SECTION T742B
PANELBOARDSAT RTC TOLL SITES

T742B-1 Description.

Furnish and install Emergency Panelboards (EDP and EP1), Power Distribution Frame (PDF) including accessories as shown in the Plans and all associated electrical conduit and cabling.

T742B-2 Materials.

742B-2.1 Standards:

Panelboards must meet the following applicable industry standards:

1. NECA Standard of Installation (published by the National Electrical Contractors Association)

2. NEMA AB1 - Molded Case Circuit Breakers

3. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies

4. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum)

5. NEMA PB 1 - Panelboards

6. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less

7. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association)

8. NFPA 70 - National Electrical Code

9. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor,

10. Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7

742B-2.2 Qualifications:

Manufacturer must be a company specializing in manufacturing the products specified in this sub-section with minimum three years experience.

742B-2.3 Maintenance Materials:

Meet the requirements of Acceptance Procedures for Toll Facilities at RTC Toll Sites.

Furnish two keys for each panelboard.

742B-2.4 Panelboards:

Provide EDP and EP1 panelboards as follows:

1. Provide NEMA PB 1, circuit breaker type panelboard with a vertically mounted main circuit breaker, a minimum of 18 one pole branch breaker spaces,.

2. Manufacturers: EDP and EP1 panelboards must meet the requirements of the contract documents and must be from one of the following manufacturers or an approved equal:

a. Schneider/Square D Co.
b. ABB/General Electric
c. Eaton/Cutler-Hammer

3. Panelboard Bus: Provide an equipment ground bus in each panelboard. Copper, ratings as indicated.

4. Integrated Short Circuit Rating: All panelboards, bussing and breakers must be fully-rated, selectively coordinated to safely interrupt available short circuit currents. The AIC ratings shown on the drawings are the minimum ratings that can be provided.

5. Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL or other NRTL listed as Type HACR for air conditioning equipment branch circuits.

6. Main Circuit Breaker Accessories: The vertically mounted main circuit breaker will be equipped with auxiliary contacts, 1a/1b, rated 6 Amps at 24 VDC.

742B-2.5 Enclosure:

1. Exterior and Wet Locations: NEMA 3R or 4X stainless steel.

2. Cabinet Front: Flush or Surface type as indicated, fastened with concealed trim clamps, hinged door with flush lock, hinged cover, welded metal directory frame, finished in manufacturer's standard gray enamel.

3. The number of utilized breaker spaces must not exceed 80% of the full breaker space capacity. 20% of the breaker spaces must remain empty.

4. Use bolt-on type circuit breakers securely fastened to the bus bars using bolts. Plug-on type or clip-on type circuit breakers are not acceptable.

5. Provide a typed circuit directory card that accurately identifies each circuit and a spare unused directory card for future use. Provide directory cards from the same manufacturer as the panelboard. Place the spare directory card behind the typed directory card in the welded metal directory card holder.

6. For nameplates of normal power, provide laminated phenolic plastic, chamfer edges, black front white core, with lettering etched through the outer covering. White engraved letters on black background.

7. For nameplates of emergency power, provide laminated phenolic plastic, chamfer edges, red front white core, with lettering etched through the outer covering. White engraved letters on red background.

T742B-3 Submittals and Shop Drawings.

Submit shop drawings in accordance with Section 5, General Requirements for Toll Site Electrical Infrastructure and the following:

1. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, withstand ratings, dimensions, and enclosure details as applicable for the following:

a. Power Distribution Frame product data including strut channel frame support material, attachment details for attaching to the concrete pad and attachment details for attaching equipment to the PDF.

b. Panelboard, circuit breakers, panel components, etc.

c. Light fixture

d. Raceway and boxes mounted to the frame

e. Fire extinguishers, cabinets, and accessories

2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Standards. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

3. Shop Drawings: Submit scaled drawings ½" = 1' showing the physical location of each panelboard. Indicate panelboard outline and support point dimensions, support frame design, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes. Include conduit routing and actual circuiting arrangements.

T742B-4 Documentation Requirements.

Provide record documents in accordance with Acceptance Procedures for RTC Toll Facilities and the following:

Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

If installed circuit breakers differ from the basis of design in the plans, perform a final coordination study, using a recognized software program to confirm that the installed equipment meets the coordination study requirements.

T742B-5 Warranty.

The panelboards under this specification section will be warranted by the manufacturer against defects in material and workmanship for a period of 1 year from the date of acceptance. The warranty will include parts, shipping costs, rigging costs, labor, and travel expenses, to replace the equipment or repair the equipment in place, in accordance with the manufacturers published service manuals.

Provide warranty documentation in accordance with Acceptance Procedures for RTC Toll Facilities.

T742B-6 Construction Requirements

742B-6.1 Panelboards:

Furnish and install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation" and the following:

1. Install panelboards plumb.

2. Provide filler plates for unused spaces in panelboards.

3. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise the directory to reflect any circuiting changes required to balance the phase loads. Provide (1) additional blank circuit directory for each branch circuit panelboard.

4. Circuit breakers must be molded case type unless noted otherwise on the plans.

5. Install the panelboards at the location and elevation depicted on the plans.

Panelboard Identification - Provide engraved plastic nameplates in accordance with the Specifications.

742B-6.2 Field Quality Control:

Prior to energizing the installed panelboard perform the following:

1. Clean the interior of the enclosure and remove all dirt and debris.

2. Perform an insulation resistance test using a MegaOhm Meter between each phase bus and ground. Investigate any reading of less than 1 MegaOhm.

3. Adjusting: Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

4. Clean installed work in accordance with Acceptance Procedures for Toll Facilities and the following:

5. Clean electrical parts to remove conductive and deleterious materials.

6. Remove dirt and debris from inside the enclosures.

7. Clean finishes and touch up damaged paint.

T742B-7 Method of Measurement.

The Contract unit price for panelboards, furnished and installed, will include furnishing, placement, and testing of the panelboards, automatic transfer switch, surge protection devices and all associated electrical equipment, conduit and cabling.

Also included are incidental work identified in the TSPs such as documentation, fire extinguisher, automatic transfer switch, power distribution frame strut channel with lighting, furnished and installed, grounding and bonding and lightning protection system for panelboards and all its components, wiring devices and identification of electrical systems associated with all equipment located on the power distribution frame, and incidentals necessary to complete the work.

The cost of general requirements for toll facilities electrical infrastructure associated with all equipment on the power distribution frame must also be included in the cost of the panelboards.

T742B-8 Basis of Payment.

Price and payment will be full compensation for all work specified in this subsection, including all materials, equipment, and accessories.

Payment will be made under:

Item No. 639-7-124 Electrical Power Service, RTC Toll Site Panelboards and Power Distribution Frame - Each

TECHNICAL SPECIAL PROVISION

FOR

WIRING DEVICES AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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SECTION T742C
WIRING DEVICES AT RTC TOLL SITES

T742C-1 Description.

Furnish and install wiring devices as shown in the Plans. Wiring devices include:

1. Wall switches / Snap switches
2. Receptacles
3. Twist-Locking receptacles
4. Device plates and box covers

T742C-2 Materials.

742C-2.1 Standards:

Wiring devices must meet the following applicable industry standards:

1. NECA - Standard of Installation
2. NEMA WD 1 - General Requirements for Wiring Devices
3. NEMA WD 6 - Wiring Device - Dimensional Requirements
4. NFPA 70 - National Electrical Code

742C-2.2 Qualifications:

Manufacturer must be a company specializing in manufacturing the Products specified in this section with minimum three years experience.

T742C-3 Wall Switches / Snap Switches.

Provide products that comply with NEMA WD 1, and are commercial specification grade, UL 20 Listed, and rated for AC only general-use.

Configuration:

1. Single pole single throw or 3 ways.

2. Switches shall be connected to the conductors using screw type mechanical pressure connectors. Spring type pressure connections are not acceptable.

3. Provide same series switch for other configurations.

4. Ratings:

   a. Voltage: 120-277 volts, AC
   b. Dielectric voltage test: Withstands 1500 Volts for 1 minute.
   c. Temperature rise: The maximum temperature rise shall not exceed 30 degrees C.
   d. Flammability: Rated V-2 per UL 94.
   e. Current: 20 Amps continuous current unless indicated otherwise on the plans.

742C-3.1 Lighting Timer Switches:

Provide 125V, 20A 4-hour twist type time delay switch in metal weatherproof box.

T742C-4 Straight Blade Receptacles.

Provide products that comply with NEMA WD 1, and are UL 498 Listed, commercial specification grade.

Features and benefits:

1. Shall be corrosion-resistant, with plated steel strap locked into the face and back body to resist pulling away from face/body assembly.

2. The brass power contacts shall be 0.032 inch thick, and utilize triple-wipe action.

3. Easily accessible break-off, line-contact connecting tab for fast, easy split-circuit wiring.

4. Impact-resistant nylon face and thermoplastic back body.

5. Accepts #14 - #10 AWG solid or stranded copper or copper-clad wire.

6. The terminal compartments shall be isolated from each other for positive conductor containment.

7. Shall be equipped with an auto-ground clip to assure positive grounding.

8. Configuration:

9. Simplex (single) or duplex outlets.

10. Receptacles installed outdoors shall be rated Weather Resistant and shall be of the ground fault circuit interrupter type.

11. Receptacles shall be connected to the conductors using screw type mechanical pressure connectors. Spring type pressure connections are not acceptable.

12. Ratings: Receptacles shall be rated as follows:

a. 20 Amp, 125 Volt, NEMA 5-20R
b. Receptacles shall meet UL 94 Flammability requirements.
c. Receptacles shall have a dielectric voltage withstand rating of 2000 Volts
d. Temperature rise of 30 degrees C after 100 cycles of overload at 150% of rated current.

T742C-5 Twist-Lock Receptacles.

Provide products that comply with NEMA WD 1, and are UL 498 Listed, commercial specification grade, meets federal specification W-C-596, and have the following features and benefits:

Configuration:

1. Simplex (single)

2. Twist lock receptacles shall be connected to the conductors using screw type mechanical pressure connectors. Spring type pressure connections are not acceptable.

3. Ratings:

a. 20 Amp, 125 Volt, 2 horsepower, NEMA L5-20R with dielectric voltage withstand rating of 2000 Volts and temperature rise of 30 degrees C after 100 cycles of overload at 150% of rated current.

b. 30 Amp, 250 Volt, 2 horsepower, NEMA L6-30R with dielectric voltage withstand rating of 2000 Volts, and temperature rise of 30 degrees C after 100 cycles of overload at 150% of rated current.

4. Receptacles shall meet UL 94 Flammability requirements of HB or better

T742C-6 Wall Plates / Cover Plates.

1. Cover Plates: Smooth thermoset plastic plates.

2. Provide labels on each wall plate and receptacle plate that show the branch circuit numbers and panelboard that serves them.

3. Weatherproof Cover Plate: Cast zinc cover plate with a "While-In-Use" cast zinc hinged weather proof and padlockable door.

T742C-7 Wiring Device Color.

Device colors shall be ivory when served by normal power, red when served by generator power, and orange when served by the critical power system.

T742C-8 Submittals and Shop Drawings.

742C-8.1 Shop Drawings:

Submit shop drawings in accordance with Section 5, General Requirements for Toll Site Electrical Infrastructure, and the following.

Shop Drawings: Call out the use or location for each device, such as "Receptacles above tolling cabinets", "general use receptacles in toll building", "twist-locking receptacle" etc on each shop drawing.

Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations and ratings. Provide specification sheets for each type of wiring device.

Manufacturer's Installation Instructions: Indicate application conditions and limitations of use. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product

742C-8.2 Warranty:

The wiring devices under this specification section will be warranted by the manufacturer against defects in material and workmanship for a period of 1 year from the date of acceptance. The warranty will include parts, shipping costs, labor, and travel expenses, to replace the equipment or repair the equipment in place, in accordance with the manufacturers published service manuals.

T742C-9 Construction Requirements.

742C-9.1.1. Examination:

Verify that outlet boxes are installed at proper height. Coordinate outlet heights with interior elevations.

Verify that wall openings are neatly cut and will be completely covered by wall plates.

Verify that floor boxes are adjusted properly.

Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

Verify that openings in access floor are in proper locations.

742C-9.1.2. Preparation:

Provide extension rings to bring recessed outlet boxes flush with finished surface. Clean debris from outlet boxes.

742C-9.1.3. Installation:

Install in accordance with NECA "Standard of Installation".

Install devices plumb and level.

Install switches with OFF position down.

Install receptacles with the grounding pole on the bottom.

Connect wiring device grounding terminal to outlet box and branch circuit equipment grounding conductor.

Install decorative plates on switch, receptacle, and blank outlets in finished areas.

Connect wiring devices by wrapping the solid conductor around the screw terminal and tightening the screw snugly. Back wiring/back stabbing is not acceptable. Stranded conductors shall be terminated with compression style lugs.

Install cast iron plates on outlet boxes and junction boxes in unfinished areas and on surface mounted outlets.

Install wiring devices as indicated on the Drawings, and as called for below.

Switches and receptacles shall be installed and located as follows, unless noted otherwise on Drawings.

Switches: Centerline 46" above finished floors.

Receptacles: Centerline 18" above finished floors generally; Verify and coordinate exact height and locations with plans and elevations.

Where light switches are located adjacent to doors, they shall be installed on "knob" side of door. Field-verify door swings.

Provide identification in accordance with the Specifications.

742C-9.2 Field Quality Control:

Inspect each wiring device for defects.

Operate each wall switch with circuit energized and verify proper operation.

Verify that each receptacle device is energized.

Test each receptacle device for proper polarity.

Test each GFCI receptacle device for proper operation.

742C-9.2.1. Adjusting:

Adjust devices and wall plates to be flush and level.

742C-9.2.2. Cleaning:

Clean exposed surfaces to remove splatters and restore finish.

T742C-10 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

AUTOMATIC TRANSFER SWITCH AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T742D
AUTOMATIC TRANSFER SWITCH AT RTC TOLL SITES

T742D-1 Description.

Furnish and install automatic transfer switch as shown in the Plans.

T742D-2 Quality Assurance.

Perform Work in accordance with NFPA 110.

The Automatic Transfer Switch must be a standard product of the original equipment manufacturer. The vendor that provides the Automatic Transfer Switch must be an Automatic Switch Company authorized manufacturer's representative. The Automatic Transfer Switch and the emergency generator shall be provided by the same vendor.

T742D-3 Materials.

742D-3.1 Standards:

Automatic Transfer switches must meet the following applicable industry standards:

1. NFPA 70 - National Electrical Code
2. NEMA ICS 1 General Standards for Industrial Control and Systems
3. NEMA ICS 2 Standards for Industrial Control Devices, Controllers, and Assemblies
4. NEMA ICS 6 Enclosures for Industrial Controls and Systems
5. U.L. – 1008, 7th Edition. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.
6. NEMA 250 – Enclosures for Electrical Equipment (1000 Volts Maximum)
7. NFPA 101 – Life Safety Code
8. NFPA 110 – Emergency and Standby Power Systems

Furnish products listed and classified by UL or other NRTL

742D-3.2 Qualifications:

1. Manufacturer: Use products from a Company specializing in manufacturing the Products specified in this section with minimum three years' experience, and with service facilities within 100 miles of Project.
2. Supplier: Authorized distributor with a minimum of five years' experience.

742D-3.3 Automatic Transfer Switch(es):

Provide a service entrance rated ATS for tolling sites with on-site power and roadside tolling cabinets (RTC). Include a molded case circuit breaker with a thermal magnetic trip unit in-line with the utility/normal service entrance feeder. Service entrance rated automatic transfer switches shall operate as delayed transition when transferring between power sources, with an adjustable time delay in the neutral position.

The service entrance rated automatic transfer switch will switch between utility/normal power and emergency generator power. The phase conductors will be switched. The neutral conductors will not be switched and will be a solid neutral connection.

Ensure the neutral bus bar is insulated from the metal enclosure.

Provide an equipment ground bar that is bonded to the metal enclosure.

Equip with a microprocessor-based control system to provide all the operational functions. Include a real-time clock with battery back-up.

1. Include a controller with a 20-character, LCD display, with keypad, which allows access to the system. Provide password protection functionality.

2. Provide with an equipment grounding bar sized to accept the conductors as shown on the electrical drawings.

3. Factory test to ensure proper operation and compliance with the specification requirements.

4. Provide as double-throw, actuated by electrical operators momentarily energized. The transfer switch must be capable of transferring successfully in either direction.

5. Provide normal and emergency main contacts that are positively interlocked mechanically and electrically to prevent simultaneous closing. Provide main contacts that are mechanically locked in both the normal and emergency positions without the use of hooks, latches, or magnets.

6. Provide such that control components and wiring are accessible from the front.

7. Provide 600-Volts SIS switchboard type for all control wires. Identify all control wire terminations with tubular, sleeve-type markers.

8. Equip each transfer switch with copper/aluminum solderless bolted pressure-type lugs rated for 90 degrees C.

9. Provide Belleville compression-type washers for bolted connections.

10. Terminate control wires with locking spade-type connectors.

11. Provide solid-state components with an operating range of -20°C to +55°C and meet IEEE Standard 472-1974.

12. Withstand Ratings:

a. Switch(es) shall be listed by Underwriters' Laboratories, Inc. or other NRTL, Standard UL-1008, 7th Edition with 3-cycle short circuit closing and withstand values for specific manufacturers breaker as follows:

Table 1- RMS Symmetrical Amperes at 480 VAC

Switch Rating in Amperes	Closing and Withstand Ratings
100 - 400	22,000
600 - 800	65,000
1000 - 1200	85,000

b. During the 3-cycle closing and withstand tests, there must be no contact welding or damage, and there must be contact continuity across all phases after completion of testing. The 3-cycle tests shall be performed without the use of current limiting fuses. Use test procedures in accordance with UL-1008, and certified by Underwriters' Laboratories, Inc. or other NRTL.

742D-3.3.1. Enclosures

Provide enclosure that meets or exceeds UL-1008 minimum wire bending space and supplied with three-point door latches. Furnish NEMA Type 4X enclosures for exterior applications. Equip with a door-mounted interior pocket, housing an operations and maintenance manual. Enclosure finish with manufacturer's standard gray enamel paint.

742D-3.3.2. SCADA Components to be Installed within the ATS Enclosure

Monitor the incoming utility/normal power feeder and monitor the incoming emergency generator feeder with power meters (Watts, Volts, Amps, pf) located remotely on the SCADA PM panel.

Mount the following accessories inside the ATS:

1. Current transformers (CT's) for the phase conductors in the incoming utility/normal service entrance feeder, and install current transformers (CT's) for the phase conductors in the incoming emergency generator feeder. Provide solid core CT's, wound type current transformers, Class B, with a 5 Amp secondary rating, accuracy class 0.5%, with a minimum burden of 10 VA.

2. Provide a CT shorting type terminal block for use with the utility/normal current transformers, and install a CT shorting type terminal block for use with the emergency generator CT's.

3. Provide voltage sensing leads for the remote normal power meter (PMN) to measure the voltage of the incoming utility/normal feeder, and provide voltage sensing leads for the remote emergency power meter (PME) to measure the voltage of the incoming emergency generator feeder. The voltage sensing leads will connect to voltage sensing terminal blocks with 2 Amp fuses for over current protection. One terminal block for use with the PMN and one terminal block for use with the PME.

4. SCADA components that are factory installed in the ATS and that will be monitored by the SCADA system:

5. Auxiliary contacts on the main circuit breaker to detect the breaker position.

6. Auxiliary contacts on the ATS to detect the position of the ATS by the SCADA system.

7. Surge protection devices, factory installed inside the ATS enclosure. One SPD will protect the utility/normal incoming feeder, and one SPD will protect the incoming emergency generator feeder. Provide SPD's with NO/NC auxiliary contacts that change state with the SPD requires service. The SCADA system will monitor the position of the SPD contacts.

742D-3.3.3. Product Options and Features

1. Adjustable, 1-phase sensing of the normal source and emergency source. Factory set to pick up at 90% and drop out at 80% of rated voltage. The adjustable frequency picks up at 95% and dropout at 93% of rated frequency. The switch shall also include phase sequence monitoring on the normal and emergency source.

2. Time delay to override momentary normal source power outages. This will delay the engine start signal and transfer switch operation. Adjustable 0 - 999 seconds. Field adjusted to 1 second during start-up.

3. Time delay on transfer to emergency. Adjustable 1-300 seconds. Field adjusted to 1 second during start-up.

4. Time delay to control contact transition time on transfer to either source.

   a. Adjustable 1-120 seconds. (Delayed Transition Only)

   b. Field adjusted to 2 seconds.

5. Time delay on retransfer to normal, adjustable 0-9999 seconds, with engine overrun to provide adjustable 0–9999 second unloaded engine operation after retransfer to normal. Field adjust the retransfer to normal time delay to 900 seconds. Field adjust the unloaded engine cool down time delay to 300 seconds.

6. "Load Test Switch" to simulate a normal power failure. (Maintained type)

7. Contact to close on failure of normal source to initiate engine starting or other customer functions.

8. Contact to open on failure of normal source to initiate engine starting or other customer functions.

9. Green pilot light to indicate switch in normal position.

10. Red pilot light to indicate switch in emergency position.

11. Plant exerciser with (10) 7-day events, programmable for any day of the week and (24) calendar events, programmable for any month/day, to automatically exercise the generating plant. Adjustable type with minimum of 1-minute increments and battery back-up. Also include selection of either "no load" (ATS will not transfer during exercise period) or "load" (ATS will transfer during exercise period). Field adjust to 'LOAD" such that the ATS will transfer to emergency during the plant exercise period.

12. An LCD display, with 1% accuracy, shall show all three separate phase to phase voltages simultaneously, for both the normal and emergency source. A digital LCD frequency readout shall display frequency for both the normal and emergency source.

13. (2) Auxiliary contacts rated 10 Amp, 120 volts AC closed when the ATS is in the normal position. Wired to a terminal strip.

14. (2) Auxiliary contacts rated 10 Amp, 120 volts AC, closed when the ATS is in the emergency position. Wired to a terminal strip.

15. Adjustable relay to prevent transfer to emergency until voltage and frequency of generating plant have reached acceptable limits. Factory set at 90% of rated value.

16. Automatic synchronizing check relay to prevent retransfer from emergency to normal until the normal and emergency sources are within acceptable limits.

742D-3.4 Automatic Sequence of Operation:

Provide the following sequence of operation:

1. Should the voltage of the normal source drop below a preset value (adjustable 70-100%) set at 80% on any phase after a time delay (adjustable 0.5-6 seconds) set at 3 seconds to allow for momentary dips, the engine starting contacts shall close to start the generating plant.

2. The transfer switch shall transfer to emergency when the generating plant has reached a preset value (adjustable 90-100%) set at 90% of rated voltage and frequency.

3. After restoration of normal power on all phases to a preset value (adjustable 70-100%) set at 90% of rated voltage, an adjustable time delay period of 0-31 minutes (factory set at 5 minutes) shall delay retransfer to allow stabilization of normal power. If the emergency power source should fail during this time delay period, the switch shall automatically return to the normal source.

4. After retransfer to normal, the emergency generator shall be allowed to operate at no load for a 5-minute period before shutting down.

5. Transfer switches shall transfer to emergency within the time limits as required by the National Electrical Code for each branch of emergency power system.

6. When more than one Automatic Transfer Switch is connected to an emergency generator, each ATS shall be programmed to switch from normal power to emergency power sequentially. The Normal to Emergency time delay shall be adjustable 1-300 seconds and shall be adjusted as shown below:

7. The Normal to Emergency time delay shall be set to 1 second for an ATS serving a critical power system.

8. The Normal to Emergency time delay shall be set to 11 seconds for an ATS serving a non-critical power system.

742D-3.5 Surge Suppression/Protection:

Provide UL-1449 third edition listed surge protection devices (SPD) in accordance with the requirements of Specification Section T742E.

Factory install a surge protection device for each incoming utility/normal service entrance feeder, and factory install a surge protection device for the incoming emergency generator feeder serving the transfer switch. The factory installed SPDs will be located on the inside of the ATS enclosure.

Documentation and Maintenance Materials

Submit the following documentation:

1. Operation Data:

a. Include instructions for operating the equipment.

b. Include instructions for operating equipment under emergency conditions when the emergency generator is running.

2. Maintenance Data:

a. Include routine preventative maintenance instructions and a lubrication schedule.
b. Provide a list of special tools, maintenance materials, and replacement parts that should be stocked.

3. Maintenance Materials:

a. Provide maintenance materials and operator's manuals.
b. Provide two (2) of each special tool required for maintenance or manual operation.

T742D-4 Maintenance Service.

Furnish service and maintenance of each transfer switch for one year from the date of Substantial Completion.

T742D-5 Shop Drawings and Submittals.

Submit shop drawings and include the following:

1. Product Data: Provide catalog sheets showing voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, withstand ratings, dimensions, and enclosure details.

2. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

T742D-6 Warranty.

The complete system provided under this specification section will be warranted by the manufacturer against defects in material and workmanship for a period of 1 year from the date of system start-up.

The warranty will include parts, shipping costs, rigging costs, labor, and travel expenses, to replace the equipment or repair the equipment in place, in accordance with the manufacturers published service manuals.

Regular and scheduled maintenance will be performed by the Department's maintenance contractor. Maintenance work by the maintenance contractor shall not void the manufacturer's warranty of the equipment.

Requirements for consumables such as filters to be original equipment manufacturer brands are not acceptable and shall not void the manufacturer's warranty of the equipment.

T742D-7 Construction Requirements.

742D-7.1 Delivery, Storage, And Handling:

Deliver, store, protect and handle products to site in accordance with General.

Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to internal components, enclosure and finish.

742D-7.2 Examination:

Verify site conditions are suitable for the ATS.

Verify that surface is suitable for transfer switch installation.

742D-7.3 Installation:

Install transfer switches in accordance with manufacturer's instructions.

Provide all associate control wiring to the generator as required.

Identification - Provide engraved plastic nameplates in accordance with the Specifications.

Provide all interface control wiring and conduit as required to provide require emergency operation of equipment on project as applicable, i.e. elevators, building automation system, fire alarm control panel, smoke control system, etc.

742D-7.4 Manufacturer's Field Services:

The manufacturers field service representative shall visit the job site a minimum of three times (sign in each time) after construction begins to coordinate the installation with the E.C and G.C. Provide assistance with concrete pad sizes and shapes, proper mounting instructions for each ATS and the quantity and routing of ATS control wiring.

Program each ATS with settings as provided by the Department.

742D-7.5 Demonstration:

Provide systems demonstration under provisions of the Specifications.

Demonstrate the proper operation of each transfer switch in normal and emergency modes. Operate each ATS manually in the presence of the Department’s representative.

T742D-8 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

SURGE-PROTECTIVE DEVICES AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

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Date: _____
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City, State, Zip Code: _____

SECTION T742E
SURGE-PROTECTIVE DEVICES AT RTC TOLL SITES

T742E-1 Description.

Furnish and install Surge Protection Devices (SPDs), 1 KV or less, to protect the normal electrical distribution system, the emergency electrical distribution system, the critical power electrical distribution system, and end-use electrical equipment from the effects of transient voltage surges. Install the surge protection devices as shown on the plans or specified in this section.

T742E-2 Materials.

742E-2.1 Standards:

SPDs must meet the following applicable industry standards:

1. UL 1449 3rd Edition, Standard for Surge Protective Devices
2. UL 1283, Standard for Electromagnetic Interference Filters
3. UL 96A Installation Requirements for Lightning Protection Systems
4. ANSI/IEEE C62.41.1-2002, C62.41.2-2002, C62.45-2002
5. IEEE Std. 1100-2005 Section 8.6.1
6. ANSI C84.1, American National Standard for Electric Power Systems and Equipment - Voltage Ratings (60 Hertz).
7. NFPA 780 - Lightning Protection Code, latest edition
8. NFPA 70 - National Electrical Code (NEC), current adopted year. Article 285
9. American National Standards Institute (ANSI) approved ANSI/NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems, 2009 edition (ANSI/NETA Acceptance Testing Specifications -2009).
10. UL 497, Standard for Protectors for Paired-Conductor Communications Circuits
11. UL 497A, Standard for Secondary Protectors for Communications Circuits
12. UL 497B, Standard for Protectors for Data Communications and Fire-Alarm Circuits
13. UL 497C, Standard for Protectors for Coaxial Communications Circuits
14. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.

742E-2.2 Definitions:

The following definitions are used in this section:

ATS ..... Automatic Transfer Switch
I Nominal (In) ..... Nominal discharge current rating as required by UL 1449, 3rd Edition
MCOV ..... Maximum Continuous Operating Voltage
VPR ..... Voltage Protection Rating (Clamping voltage)
SCCR ..... Short Circuit Current Rating
SPD ..... Surge Protective Device

742E-2.3 System Description:

Provide surge protective devices (SPDs) for the following systems and equipment:

1. Each main electrical service panel and MDP as shown on the drawings. Include branch circuit breakers in the main service panel to disconnect and protect the surge protective device and its connecting conductors.

2. Each emergency electrical distribution panel (EDP).

3. Each distribution and branch panel as shown on the drawings. Include branch circuit breakers in the distribution and branch panels to disconnect and protect the Surge Protective Device and its connecting conductors.

4. Site lighting circuits.

5. Electronic equipment installed as identified in the Contract Documents, including electronic time clocks, controls systems, access control system, telephone, CCTV, SCADA control panel, etc.

6. Communications and signaling circuits that travel outdoors will be protected with low voltage, fast acting, surge protection devices.

7. On each emergency power feeder entering the enclosures and before the emergency feeder is connected to Automatic Transfer Switch.

8. On all telephone lines, DSL lines, T1 lines where they enter the enclosure or at the telephone board.

9. Additional locations as required by NFPA 780.

Existing SPDs shown on the drawings shall remain active unless noted for replacement.

Provide the best type of SPD that matches these specifications and matches the equipment being protected.

Install SPDs on the inside or outside of control panels and electrical equipment.

742E-2.4 Surge Protective Devices:

Furnish SPDs manufactured by one of the following:

1. Advanced Protection Technologies

2. Emmerson/Liebert

3. L.E.A. International

4. Approved equal - Any product that meets or exceeds the performance of the above manufacturers will be considered.

Furnish SPDs rated for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage

5. Operating Temperature: 30 to 120 deg F (0 to 50 deg C)

6. Humidity: 0 to 85 percent, no condensing

7. Altitude: Less than 20,000 feet (6090 m) above sea level

742E-2.4.1. Service Entrance Surge Protective Device

Furnish surge protective device with the following minimum features and accessories:

1. Each SPD shall be UL 1449 third edition listed and labeled as a Type 1 suppressor intended for use without the need for external or supplemental overcurrent protection.

2. Each SPD shall be labeled with 20kA I-nominal (In) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780.

3. Each SPD shall be of modular construction such that each of the SPD modules may be field replaced without the need to remove the entire SPD enclosure.

4. Install the SPD externally to the distribution equipment with the leads as short and straight as possible. Gently twist the conductors together. Installer may reasonably rearrange breaker locations to ensure short and straightest possible leads to the SPD. If any lead lengths exceed 24", the Contractor responsible for installation must contact the specifying electrical engineer for additional installation instructions.

5. Each SPD shall be installed with a branch circuit breaker as a disconnecting means or provide an integral factory installed disconnect switch as a disconnecting means.

6. Each SPD will have the following modes of protection: Line to Line, Line to Neutral, Line to Ground, and Neutral to Ground.

7. The SPD shall include visual LED indicator lights for power and protection integrity.

8. Each SPD shall contain one set of form C contacts that change state when the SPD requires service.

9. Minimum Surge Current Capability: 200 kA per phase with less than 1 nanosecond response time.

10. Connection Means: Permanently wired, connected on the load side of the service entrance overcurrent protection, and meet the SPD manufacturer's instructions for overcurrent protection (breaker or fuse size).

11. Protection modes and UL 1449 3rd Edition VPRs for circuits with voltages of 120/240V, 1-Phase, 3-Wire shall not exceed:

a. Line to Neutral:	700V for 120/240V, 1PH, 3W
b. Line to Ground:	700V for 120/240V, 1PH, 3W
c. Neutral to Ground:	700V for 120/240V, 1PH, 3W
d. Line to Line:	1200V for 120/240V, 1PH, 3W

742E-2.4.2. Surge-Protective Device for Distribution Panelboards

Furnish surge protective device with the following minimum features and accessories:

1. UL 1283 listed as an Electromagnetic Interference Filter
2. SPD shall be UL 1449 Third Edition, labeled as Type 1 intended for use without need for external or supplemental overcurrent controls or labeled as Type 2 with manufacturer approved over current protection
3. SPD shall be UL 1449 Third Edition labeled with 20kA nominal discharge current (I_n) (verifiable at UL.com) for compliance to UL 96A Lightning Protection Master Label and NFPA 780
4. SPD marked with a 200kA short-circuit current rating (SCCR)
5. Modes of Protection: Line to Neutral, Line to Ground, Line to Line, and Neutral to Ground
6. The SPD shall include visual LED indicator lights for power and protection integrity
7. Arrangement with wire connections to phase buses, neutral bus, and ground bus
8. Each SPD shall contain one set of form C contacts that change state when the SPD requires service
9. Minimum Surge Current Capability: 150 kA per phase
10. Protection modes and UL 1449 3rd Edition VPRs for circuits with voltages of 120/240V, 1-Phase, 3-Wire shall not exceed:
    a. Line to Neutral: 700V for 120/240V, 1PH, 3W
    b. Line to Ground: 700V for 120/240V, 1PH, 3W
    c. Neutral to Ground: 700V for 120/240V, 1PH, 3W
    d. Line to Line: 1200V for 120/240V, 1PH, 3W

742E-2.4.3. Surge-Protective Device Direct Wired (120 VAC)

Furnish surge protective device with the following minimum features and accessories:

1. SPD shall be UL 1449 3rd Edition listed/recognized
2. 15 & 30 Amp, 120 V rated. All continuous current bearing components must be either 15 or 30 Amp rated, minimum; depending on Location Load usage
3. SPDs shall provide three suppression modes: Line-to-neutral, line-to-ground, and neutral-to-ground
4. SPD shall provide a pulse life rating of 3,000 amperes (8/20µs waveform) every thirty (30) seconds for 2,000 occurrences
5. Peak Single-Impulse Surge Current Rating: 20kA per mode, 60kA per protected circuit
6. SPD shall include visual LED diagnostic indicator for power and protection integrity
7. SPD shall allow for chase nipple or DIN RAIL mounting

742E-2.4.4. Data Line, Ethernet, RS 422, and RS-232 Surge-Protective Device

Furnish surge protective device with modular DIN RAIL design and the following minimum features and accessories:

1. Listed and meets the requirements of UL 497A, UL 497B, or UL 497C as applicable.
2. Plug-in replaceable DIN RAIL modules
3. Employs hybrid circuitry that combines metal oxide varistors with silicon avalanche diodes

4. Let through voltages for SPD's protecting the following circuits shall not exceed the following:

a. Ethernet – 10 Volts

b. Power over Ethernet – 75 Volts

c. RS 485 – 10 Volts

d. RS 232 – 27 Volts

e. Coaxial – 90 Volts

f. 4 – 20 milliAmp – 30 Volts

g. Peak Single-Impulse Surge Current Rating: 10 kA per mode

5. Subject to compliance with requirements, provide products by one of the following for data line SPDs:

a. Advanced Protection Technologies/Surgeassure

b. Superior Electric/Stabiline

c. Circa Telecom

d. Emerson Network Power

e. Scientific Atlantic

f. Surge Suppression Incorporated

742E-2.4.5. Telephone Line Surge-Protective Device

Furnish surge protective device with modular design and the following minimum features and accessories:

1. Listed and meets the requirements of UL 497A, UL 497B, or UL 497C as applicable
2. Plug-in replaceable modules design to fit on standard M1-50, 66 connecting block
3. Must be installed with matching ground rail or external ground post for extending metallic frame to building ground
4. The SPD's will be rated for Nominal line voltage of 150 Volts, Maximum line voltage of 170 Volts, and the maximum clamping voltage shall be 190 Volts
5. The nominal discharge current with an 8x20 µs impulse will be 5kA

742E-2.4.6. Ethernet Surge Protective Devices (SPD)

Furnish SPD's for each Ethernet cable that is routed underground or to a different outdoor enclosure. Ethernet SPD's will be rated for data transmission speeds up to 10 GB per second without signal degradation. Ethernet cables will contain four sets of unshielded twisted pairs of copper conductors. The SPD will provide common mode, and differential mode protection.

1. The SPDs will be UL Listed in accordance with UL 497A, UL 497B, or UL 497C.
2. Provide plug-in replaceable DIN rail mounted SPD modules that are the "in-line" type that is connected in series with the Ethernet communications conductors.
3. The SPD's shall employ hybrid circuitry that combines silicone avalanche diodes with gas discharge modules. The SPD response time shall be one nano-second or less.
4. The nominal discharge current (In) shall be 4 kV / 2 kA, and the maximum surge current rating shall be 16 kA.

742E-2.4.7 Modbus (RS-485) communications Surge Protective Devices (SPD)

Furnish SPD's for each Modbus communication circuits. Each Modbus circuit will consist of one twisted shielded pair of copper conductors with operating voltages of -7V to +12V.

1. The SPD's will be DIN rail mounted and connected "In-Line" in series with the Modbus communication circuits
2. The SPD's will meet the requirements of IEC 61643-21 with certification to UL 497B
3. The SPD's will contain three stage high energy surge suppression. Stage 1 will consist of parallel connected gas discharge tubes. Stage 2 will have a series connected impedance. Stage 3 will consist of parallel connected transorb diodes
4. The SPD maximum continuous operating voltage (MCOV) will be 15 VDC
5. The clamping voltage must be < 27 VDC
6. The typical breakdown voltage will be 18 VDC
7. The surge current rating will be 15 kA, and the response time will be one nano-second or less
8. The IEC maximum discharge current, I nominal (8x20 µs) will be 10 kA.

742E-2.4.8 24 VDC Signaling circuits, and 4-20 milli-Amp current circuit Surge Protection Devices

1. The SPD's will be DIN rail mounted and connected "In-Line" in series with the signaling communication circuits.
2. The SPD's will meet the requirements of IEC 61643-21 with certification to UL 497B.
3. The SPD's will contain three stage high energy surge suppression. Stage 1 will consist of parallel connected gas discharge tubes. Stage 2 will have a series connected impedance. Stage 3 will consist of parallel connected transorb diodes.
4. The SPD maximum continuous operating voltage (MCOV) is 28 VDC.
5. The clamping voltage must be < 46 VDC.
6. The typical breakdown voltage will be 33 VDC.
7. The surge current rating will be 15 kA.
8. The IEC maximum discharge current, I nominal (8x20 µs) will be 10 kA.

742E-2.5 Enclosures:

Furnish NEMA Type 1 enclosures for all enclosures inside of the building and NEMA Type 4X enclosures for exterior applications.

T742E-3 Quality.

All SPDs shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electrical and electronics systems equipment for a minimum of five years.

Manufacturing facility shall operate a Quality System Certified as ISO 9001:2008 (or latest version) Compliant.

The SPD manufacturer shall provide requested technical assistance through support (including on-site as needed) by a factory-trained representative.

Source Limitations: Obtain SPDs and accessories for like applications through one source from a single manufacturer located in the United States.

Product Options: Drawings indicate size, dimensional requirements, and electrical performance of SPDs and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements".

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

T742E-4 Submittals and Shop Drawings.

Submit in accordance with Section 5, General Requirements for Toll Site Electrical Infrastructure, and the following:

1. Product Data: For each type of product indicated. Include rated capacities, bill of materials of number of MOVs installed per phase with MOV part number and surge current rating, operating weights, operating characteristics, furnished specialties, and accessories.

2. Product Certificates: SPD submittals shall include Listing documentation, signed by product manufacturer certifying compliance with the following standards:

3. UL 1283 compliance verified information is posted at www.UL.com, under Certifications, searching using UL Category Code: FOKY.

4. UL 1449 3rd Edition certification listing and classification page, VPR, MCOV, In, and Type 1 information is posted at www.UL.com, under Certifications, searching using UL Category Code: VZCA. SCCRs are posted in manufacturer's UL docs.

5. UL 497, UL 497A, UL 497B, UL 497C as applicable.

6. Field quality-control test reports, including the following:

a. Test procedures used.

b. Measure the continuity of each conductor between the equipment being protected and the SPD. The maximum resistance is 1 milliohm.

c. Failed test results and corrective action taken to achieve requirements.

7. Operation and Maintenance Data: For Surge protective Devices to include in emergency, operation, and maintenance manuals.

8. Warranties specified in this Section.

742E-4.1 Operation and Maintenance Data Submittals.

Submit operation and maintenance (O&M) data as called for in Acceptance Procedures for Toll Facilities. O&M data to include:

1. All approved shop drawings, product data, and/or cutsheets.

2. Installation, connection, and maintenance information on each type of surge suppression.

3. Procedure and/or timetable for recommended periodic inspection of devices to determine continued usefulness, as applicable.

T742E-5 Warranty.

Provide warranties in accordance with the following:

1. Manufacturer's standard form in which manufacturer agrees to repair or replace components of SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

2. For Data line SPDs, Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge SPDs that fail in materials or workmanship within two years from date of Substantial Completion.

3. Any SPD, that shows evidence of failure or incorrect operation during the warranty period (to include failure of visual failure indicators) shall be replaced or repaired by the manufacturer during the warranty period. The manufacturer shall provide replacement units to the Department for installation.

T742E-6 Construction Requirements.

Install SPDs that bear the UL seal and are marked in accordance with the referenced standard for the intended use. Install SPDs located in accordance with requirements of all applicable National Fire Protection Association (NFPA) codes (including NFPA 780 and NFPA 70) and in compliance with the standards listed in T742-9.1.

742E-6.1 Verification of Project Conditions:

Prior to installation coordinate and verify existing project conditions and progress as follows:

1. Verify proper grounding is in place.

2. Verify proper clearances, space, etc. is available for SPD.

3. Coordinate so that proper overcurrent device, as recommended by manufacturer, is installed to feed each surge suppression device.

4. Existing Utilities:

a. Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

b. Notify Department not less than two days in advance of proposed utility interruptions.

c. Do not proceed with utility interruptions without Department's written permission.

742E-6.2 General:

Provide, install, and connect an SPD’s at the first electrical service disconnecting means. Branch breakers in the MDP shall serve as the disconnecting means for the SPD.

Provide, install and connect an SPD at each branch panelboard that serves outdoor equipment. Branch breakers in the panelboard shall serve as the disconnecting means for the SPD.

Provide, install and connect an SPD to protect the emergency generator feeder at each Automatic Transfer Switch (ATS) in project. The SPD will include an integral disconnecting means installed by the SPD manufacturer.

Provide, install, and connect SPD at location where CCTV, access control and communication equipment is connected to line voltage (120V). Provide cords and receptacles as required to connect SPD equipment to equipment being protected and maintain U.L. listing.

Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.

Installation of SPD equipment and its grounding must be in accordance with the manufacturer's recommendations to assure short and proper ground paths.

Install external SPDs with a maximum of 24" length leads. Position the SPD as close to the circuit breaker used as possible. Utilize the breakers closest to the SPD mounting. Install the leads slightly twisted together, but as short and straight as possible with no kinks or coils and an eight-inch minimum bending radius.

742E-6.3 Installation of SPDs:

Except for CCTV, access control and communication equipment, install SPDs as close as practical to the electric panel or electronic equipment to be protected, consistent with available space.

SPDs must be close-nippled to the device being protected in a position nearest the neutral bus (if present) to minimize wire lead length between SPD and the buses or control breaker to which the SPD connects. SPD leads must not extend beyond the SPD manufacturer's recommended maximum lead length without specific approval of the engineer.
Install SPDs in a neat, workmanlike manner. Lead dress must be as short and as straight as possible and be consistent with recommended industry practices for the system on which these devices are installed.

Install SPDs in a manner that allows simple replacement within short periods of downtime.

Except for point of use type SPDs, install a means of disconnecting the SPD at the panel. At the MDP locations, provide a dedicated 60 amp, breaker for the SPD device. At the distribution secondary and/or subpanels location, provide dedicated 30 Amp, breaker for the SPD device. Change rating of CB's noted above as required to properly provide system as recommended by manufacturer.

742E-6.4 SPD for Service Entrance and PanelBoards:

Install the SPD externally to the distribution equipment with the leads as short and straight as possible. Gently twist conductors together. Installer may reasonably rearrange breaker locations to ensure short and straightest possible leads to the SPD. If any lead lengths exceed 24", the Contractor responsible for installation must contact the specifying electrical engineer and the surge protective device manufacturer or distributor for installation assistance.

742E-6.5 Telephone Circuits:

Systems utilizing telephone company pairs as a transmission medium shall be provided with SPD conforming to respective device in Part 2 of this specification.
SPDs shall be installed at each point where interface is made to telephone company pairs.

In cases where a modem or other device is used to interface with the telephone circuit the following procedure shall apply:

Where the modem or coupling device is furnished by the telephone company the SPDs shall be installed on the system side of the modem or coupling device.

Where the modem or coupling device is furnished by the system contractor, the SPD shall be installed on the telephone line side of the modem or coupling device.

742E-6.6 Signaling, Communications and Data Conductors:

Any signaling conductor, CCTV conductor, Ethernet conductor, Power over Ethernet (PoE) conductor, or SCADA system conductor that is routed in an exterior environment shall be protected by a surge protection device (SPD). The SPD's will be mounted indoors where possible.

742E-6.7 Placing System into Service:

Before energizing any SPD, the installer shall measure the electrical system voltage and frequency and verify that each SPD is properly rated for use with measured voltage and frequency.

742E-6.8 Field Quality Control:

Verify that electrical wiring installation complies with manufacturer's written installation requirements.

Testing: Perform the following field tests and inspections.

a. After installing surge protective devices, but before the electrical circuitry has been energized, measure the continuity of each lead. Measure between the equipment being protected and the point of connection to the SPD.

b. Complete startup checks according to manufacturer's written instructions.

T742E-7 Demonstration.

Department's maintenance personnel to adjust, operate, and maintain SPDs.

T742E-8 Method of Measurement.

The work specified in this Section will not be measured but will be included in the pay items for panelboards and outdoor communications cabinet.

T742E-9 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

LIGHTING FIXTURES AND LAMPS AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T742F
LIGHTING FIXTURES AND LAMPS AT RTC TOLL SITES

T742F-1 Description.

Furnish and install lighting fixtures and lamps as shown in the Plans.

T742F-2 Materials.

742F-2.1 Standards:

Lighting fixtures and lamps must meet the following applicable industry standards:

1. NEMA WD 6 - Wiring Devices-Dimensional Requirements
2. NFPA 70 - National Electrical Code
3. NFPA 101 - Life Safety Code

742F-2.2 Qualifications:

Manufacturer must be a company specializing in manufacturing the products specified in this sub-section with minimum three years documented experience.

742F-2.3 Luminaires:

Provide luminaires in accordance with the lighting fixture schedule in the Plans.

742F-2.4 Exterior LED Light Fixtures:

Provide Flat face, low profile, wall mount, exterior light fixtures in accordance with the Plans and the following:

The baseplate must be manufactured from marine grade die-cast aluminum. The baseplate flange shall interlock and wrap around the lens base to prevent water intrusion.
Lens: The lens must be made from ultraviolet stabilized, high impact resistant, virgin injection molded polycarbonate. Ensure the lens is held in place by a push/turn/lock in place device that does not require tools. The lens and lens base will be secured with a single, concealed, captive fastener with a center pin.

Gasketing: A self-adhesive neoprene gasket must seal between the baseplate to the mounting surface.

The LED light source color temperature must be 3500 degrees Kelvin with a minimum CRI of 82.

T742F-3 Submittals and Shop Drawings.

Submit documents in accordance with Section 5 and General Requirements for Toll Site Electrical Infrastructure . Submit manufacturer's operation and maintenance instructions for each product.

T742F-4 Construction Requirements.

742F-4.1 Installation:

Furnish and install luminaires in accordance with the following:

Install exterior mounted luminaires, at height as indicated on Drawings, as scheduled.

Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within the luminaire.

Bond products and metal accessories to the branch circuit equipment grounding conductor.

Surface mounted fixtures and boxes shall be supported to superstructure and/or strut channel frame with all-thread rod.

Light fixtures shall not have any labels exposed to normal viewing angles. This includes manufacturer labels and U.L. labels.

Provide low voltage transformers and power supplies for all low voltage light fixtures.

742F-4.2 Field Quality Control:

Operate each luminaire after installation and connection. Inspect for proper connections and operation.

Aim and adjust luminaires as indicated.

742F-4.3 Cleaning:

Clean installed work in accordance with Acceptance Procedures for Toll Facilities at RTC Toll Sites and the following:

1. Clean electrical parts to remove conductive and deleterious materials.
2. Remove dirt and debris from inside the enclosures.
3. Clean photometric control surfaces as recommended by manufacturer.
4. Clean finishes and touch up damaged areas.

T742F-5 Acceptance Procedures.

Demonstrate luminaire operation for minimum of two hours during Primary Walk Through. See Acceptance Procedures at Toll Facilities for RTC Toll Sites.

Re-lamp any luminaires that have failed lamps at Substantial Completion

T742F-6 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

STATIC UNINTERRUPTIBLE POWER SUPPLY SYSTEMS FOR OUTDOOR COMMUNICATION CABINETS AT RTC TOLL SITES

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
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City, State, Zip Code: _____

SECTION T742G
STATIC UNINTERRUPTIBLE POWER SUPPLY SYSTEMS FOR OUTDOOR COMMUNICATION CABINETS AT RTC TOLL SITES

T742G-1 Description.

Provide all labor, materials, services, testing, and equipment necessary to provide Static Uninterruptible Power Supply (UPS) systems with internal bypass at each RTC toll site.

T742G-2 Materials.

742G-2.1 Standards:

1. UL 1778 - Underwriters Laboratory. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.

2. FCC rules, part 15 – Limits for a Class A digital device

3. IEEE C62.41 - Guide on Surge Voltages in AC Power Circuits Rated up to 600V

4. IEEE 519 – Recommended Practices for Harmonic Control in Electrical Power Systems

5. NFPA 70 - National Electrical Code

742G-2.2 UPS System Requirements:

Provide two, separate, rack-mounted uninterruptible power supply (UPS) systems within each Outdoor Communications Cabinet (OCC).

742G-2.2.1. UPS System for OCC Equipment:

Provide critical/clean power to the electrical equipment within the OCC with a 2000 VA, 1800 Watts, UPS system in accordance with the following:

1. Provide UPS with 120 Volt input, 120 Volt output, 60 Hz, single phase, 2 wire, plus ground.

2. Provide continuous, high quality, conditioned, 120 Volt AC sinewave output power to the electrical equipment within the OCC.

3. Output power from the UPS will be distributed by a cord and plug connected Power Distribution Unit (PDU) with twelve 120 Volt simplex receptacles, NEMA 5-15R/NEMA 5-20R.

4. The UPS will protect the electrical equipment in the OCC from power disturbances on the power distribution system due to power blackouts, brownouts, surges, or noise interference.

5. AC INPUT SUPPLIED TO THE UPS SYSTEM:

a. Input Voltage: 120 Volts, single phase, 2 wire - plus ground.

b. Input AC power for the UPS will be delivered by a 10 foot long, factory installed, cord and plug. The plug will be a twist lock, NEMA L5-20P.

c. Ensure that the UPS will be served by a dedicated feeder that is not spliced or tapped by other feeders.

d. Voltage Range: The incoming AC power voltage range will be between 60 Volts and 150 Volts. Nominal voltage is 120 Volts AC.

e. Frequency range: The UPS will operate when the AC frequency is between 40 Hz and 70 Hz. Nominal frequency is 60 Hz.

f. Frequency: Auto-sense input frequency when first powered up and operate within the following frequency specifications. UPS must be capable of cold start with default frequency of 60Hz. Once started, the frequency operating window must be 40-70Hz. Provide three frequency settings in the Configuration program: Auto frequency sensing (factory default setting), 50Hz frequency conversion and 60Hz frequency conversion.

g. Input Power Factor: >0.99 lagging at rated load.

h. Input Current Harmonic Distortion: THD must be less than or equal to 5% at nonlinear, full load operation.

i. Input current rating: The input current rating will be 16 Amps at 120 Volts.

j. Inrush Current (initial startup, no load): Provide a UPS with a maximum inrush current of 6 times the full load peak input current.

k. Surge Immunity & Protection: UPS must conform to ANSI C62.41, Category B.

6. AC OUTPUT FROM THE UPS SYSTEM:

a. The UPS output voltage will be 120 Volts, AC, single-phase, 60 Hz, 2 wire, plus ground.

b. Output power will be delivered from a 120 Volt AC, 20 Amp, twist lock simplex receptacle, NEMA L5-20R located on the back of the UPS.

c. Output power from the UPS will be distributed by a cord and plug connected Power Distribution Unit (PDU) equipped with twelve 120 Volt simplex receptacles, NEMA 5-15R/NEMA 5-20R. The PDU will accept power from the UPS by a 10 ft long cord and plug. The plug will be a twist lock type plug, NEMA L5-20P.

d. The PDU will be mounted vertically within the Outdoor Communications Cabinet.

e. Voltage Regulation: +/- 1% steady state.

f. Frequency Regulation: ±3.5 Hz synchronized to utility. ±0.1 Hz free running or on-battery operation.

g. Frequency slew rate: 1.0 Hz per second, maximum.

h. Voltage Distortion: Less than 2% total harmonic distortion (THD) typical into a 100% linear load, less than 5% THD typical into a 100% non-linear load.

i. Load Power Factor Range: The load power factor range shall be 0.65 lagging to 1.0 (unity) without power derating.

j. The maximum UPS output power rating will be 2000 VA, 1800 Watts.

k. Inverter Overload Capability

Overload Percent	Duration Inverter must support rated load
105% to 125%	60 seconds
125% to 150%	50 seconds
150% to 200%	2 seconds

l. Voltage Transient Response: The transient response of the output voltage with resistor step loading will be +/-5% for input supply from off to on and for a load from 0% to 100% and 100% to 0%. Transient response in the output voltage with resistor step loading will be +/-4% for input supply from off to on and for a load from 20% to 100% and 100% to 20%.

m. Transient Recovery Time: To nominal voltage within 60 ms.

n. AC-AC Efficiency: The UPS must be EPA Energy Star Qualified with a 93% AC – AC at full rated linear load.

o. Programmable and Controllable 120 Volt Receptacle Outlets: The UPS will have four simplex receptacle outlets, 120 Volt AC, 20 Amps, These receptacle outlets will be programmable and/or controllable. These outlets will be user customizable to perform load shedding based upon the remaining battery capacity, time on battery operation, battery time remaining, and overload condition when on battery power. The user shall be able to program these receptacles for sequential restart of connected equipment based on the amount of time after input/normal power is restored. The user can also program these receptacles to always be turned off. To prevent unauthorized equipment from being plugged into the UPS.

7. BATTERY

a. Internal Battery: The batteries will consist of flame retardant, valve regulated, non-spillable, lead acid cells.

b. Reserve Time: Beginning with fully charged batteries, and the ambient temperature at 77° F, the UPS will provide high quality, conditioned, output power for 4 minutes at full (100% rated) load with no AC input power to charge the batteries.

c. The UPS will provide high quality, conditioned, output power for 12.3 minutes when the output load is 50% of the full rated load with no AC input power to charge the batteries. The UPS shall be capable of interfacing with an external battery cabinet to extend the reserve time capabilities.

d. Battery Recharge: The UPS will have a three stage battery charger designed to prolong the battery life. After a full battery discharge, the battery charger will recharge the batteries to 90% capacity within four (4) hours.

742G-2.2.2. UPS System for RTC Cabinet.

Provide critical/clean power to the Roadside Tolling Cabinet (RTC) with a 5000 VA, 5000 Watts, UPS system, rack mounted within the OCC, as follows:

1. Provide an UPS system with 120/240 Volt input, single phase, and 120/240 Volt output, 60 Hz, single phase, 3 wire, plus ground.
2. Provide continuous, high quality, conditioned, 120/240 Volt AC, 60 Hz, sinewave output power to the tolling equipment within the RTC.
3. Output power from the UPS will be distributed by a hard wired, feeder circuit routed underground to the RTC.
4. The UPS will protect the tolling equipment within the RTC from power disturbances on the normal power distribution system due to power blackouts, brownouts, surges, or noise interference.
5. AC INPUT SUPPLIED TO THE UPS

a. Input Voltage: 120/240 Volts, single phase, 60 Hz, 3 wire - plus ground.

b. Input AC power for the UPS will be delivered by a hard wired feeder circuit.

c. Ensure that the UPS will be served by a dedicated feeder that is not spliced or tapped by other feeders.

d. Voltage Range: The UPS will operate properly when the incoming AC power voltage is between 176 Volts and 280 Volts. Nominal voltage is 120/240 Volts AC.

e. Frequency range: The UPS will operate properly when the AC frequency is between 40 Hz and 70 Hz. Nominal frequency is 60 Hz.

f. Input current harmonic distortion: Total Harmonic Distortion (THD) shall be less than, or equal to 3% when operating at linear full load operation. THD shall be less than or equal to 5% when operating at non-linear full load operation.

g. Inrush Current: Upon initial startup with no load, the UPS shall have a maximum inrush current of 6 times the full load input current.

h. Voltage: The point at which the UPS transfers to battery operation must be dependent on the amount of load that the UPS is supporting. The UPS must operate from the following voltage ranges without drawing power from the batteries:

i. Low Line Voltage Range

j. From 0 to 50%load the low line voltage is constant.

k. From 51-100% load the low line voltage increases at a linear rate.

l. For loads over 100%, the low line voltage remains constant.

Load		Low Line Voltage
100% to 51%	L-N Transfer	60 - 90 ± 3.1VAC
	L-N Comeback	68 - 98 ± 3.1VAC
50% to 0%	L-N Transfer	60 ± 3.1VAC
	L-N Comeback	68 ± 3.1VAC

High Line Voltage Range	
High Line Voltage	120/208V Models
High Line Transfer	149.5 ± 3.1VAC
High Line Comeback	142.5 ± 3.1VAC

m. Frequency: Auto-sense input frequency when first powered up and operate within the following frequency specifications. UPS must be capable of cold start with default frequency of 60Hz. Once started, the frequency operating window must be 40-70Hz. Provide three frequency settings in the Configuration program: Auto frequency sensing (factory default setting), 50 Hz frequency conversion and 60 Hz frequency conversion.

n. Input Power Factor: >0.99 lagging at rated load.

o. Input Current Harmonic Distortion: THD must be less than or equal to 3% at linear, full load operation. THD must be less than or equal to 5% at nonlinear, full load operation.

p. Inrush Current (initial startup, no load): Provide with a maximum inrush current of 6 times the full load peak input current.

q. Surge Immunity & Protection: UPS must conform to ANSI C62.41, Category B.

6. AC OUTPUT FROM THE UPS

a. The UPS output voltage will be 120/240 Volts, AC, single-phase, 60 Hz, 3 wire, plus ground.

b. Output power from the UPS will be distributed by a hard wired, feeder circuit (L1, L2, N, G) routed underground to the RTC.

c. Voltage Regulation: +/- 1% steady state.

d. Voltage Distortion: Less than 2% total harmonic distortion (THD) typical into a 100% linear load, less than 5% THD typical when into 100% non-linear load.

e. Frequency Regulation: 60 Hz, +/- 3.5 Hz when synchronized to the bypass power. +/- 0.1 Hz when running on battery power.

f. Frequency slew rate: Slew rate shall be 1.0 Hz per second maximum.

g. The maximum UPS output power rating will be 5000 VA, 5000 Watts at 0.9 lagging power factor.

h. Load power factor range: The load power factor range shall be 0.65 lagging to 1.0 unity without power derating.

i. Inverter overload capability: The inverter shall support the output load for 5 minutes when it is overloaded between 105% and 125%, and the inverter will continue to support the output load when it is overloaded between 125% and 150% for 60 seconds.

j. Voltage Transient Response: The transient response of the output voltage with resister step loading will be +/- 5% for input supply from off to on, and for a load from 0% to 100%, and from 100% to 0%. Transient response in the output voltage with resister step loading will be +/- 4% for input supply from off to on, and for a load from 20% to 100%, and 100% to 20%.

k. Transient recovery time: The output voltage will recover to nominal voltage within 60 milli-seconds.

l. AC – AC efficiency: The UPS unit shall be EPA Energy Star Qualified. The efficiency of the UPS shall be 93% at full rated linear load.

7. BATTERY

a. Internal Battery: The batteries will consist of flame retardant, valve regulated, non-spillable, lead acid cells.

b. Reserve Time: Beginning with fully charged batteries, and the ambient temperature at 77°F, the UPS will provide high quality, conditioned, output power for 4.5 minutes at full (100% rated) load with no AC input power to charge the batteries.

c. The UPS will provide high quality, conditioned, output power for 12.5 minutes when the output load is 50% of the full rated load with no AC input power to charge the batteries. The UPS shall be capable of interfacing with an external battery cabinet to extend the reserve time capabilities.

d. Battery Recharge: The UPS will have a three stage battery charger designed to prolong the battery life. After a full battery discharge, the battery charger will recharge the batteries to 90% capacity within four (4) hours.

742G-2.3 Environmental Conditions:

1. Ambient Temperature: When the UPS is operating, the ambient temperature range shall be between 32° F and 104° F. There shall be no degradation in the performance of the UPS when operating in this temperature range. Automatic derating of the output power rating shall occur if the UPS is operated in a higher ambient temperature than 104° F.
2. Storage Temperature. The UPS can be stored (not operating) when ambient temperatures are between 5° F and 104° F.
3. Relative humidity: When operating, or when in storage, between 0 to 95% non-condensing.
4. Altitude: The UPS will operate normally without power derating when the altitude is 10,000 feet or lower.
5. Audible Noise: The audible noise of the operating UPS will be 48 dBA, or less, at 1 meter from the front, sides, or rear of the UPS.

742G-2.4 Modes of Operation:

The UPS must operate as a true on-line double-conversion system in the following modes:

1. Normal - In normal operation incoming AC power will be supplied to the input power factor corrected rectifier that converts the AC power to DC power for the inverter. In this mode, power shall also be derived from the incoming power for the battery charger. The battery charger maintains a float-charge on the battery. The inverter will use DC power from the rectifier to regenerate filtered and regulated AC sinewave power for the connected loads. If incoming AC power is interrupted, or if the voltage or frequency is not within nominal range, the inverter will use DC battery power to generate 120 Volt AC output power until the incoming power is restored, or until the battery is discharged.

2. Back-up - Upon failure of incoming AC power, the critical AC load is supplied by the inverter, which without any switching obtains power from the battery. There will be no interruption in power to the critical load upon failure or restoration of normal incoming power to the UPS.

3. Recharge - Upon restoration of incoming AC power, the input rectifier will automatically restart and resume supplying DC power to the inverter. The battery charger will resume charging of the battery .

4. Automatic Restart - After a utility / mains AC power outage and complete battery discharge, automatically restart the UPS and resume supplying power to the critical load and to the battery charger which will automatically recharge the battery upon restoration of utility / mains AC power. This feature must be capable of being disabled by the user.

5. Automatic Restart - Upon restoration of normal incoming AC power, after an incoming AC power outage, and complete battery discharge, the UPS will automatically restart and resume supplying power to the critical load. In addition, the battery charger will automatically recharge

the battery. This feature must be enabled (factory default) and will be capable of being disabled by the user.

6. Bypass - The internal bypass will provide an automatic transfer of the critical AC power from the inverter to the bypass source in the event of an overload, PFC failure, internal over temperature, DC bus overvoltage, or inverter failure. .

7. ECO –The UPS will allow the user to enable and place the UPS in ECO mode of operation to reduce the electrical power consumption. The ECO mode operation shall be an Active type, whereas the UPS will power the connected equipment through the bypass path and the UPS inverter shall be on and operating at no load in order to stay synchronized with the bypass to ensure rapid transfers to inverter power when input power falls outside of the user customizable parameters. The UPS shall also have a user customizable requalification time that input power must remain within the ECO mode parameters before transferring back to ECO operation.

742G-2.5 Cabinet:

Ensure the UPS unit(s) are comprised of: A user interface module, an input PFC converter, an IGBT inverter, a battery charger, input filter, an internal bypass circuit, sealed battery cells, and shall be housed in a rack mountable NEMA 1 enclosure and must meet the requirements of IP20. The UPS cabinet shall be cleaned, primed, and painted with the manufacturer's standard color.

742G-2.6 Cooling:

Provide forced-air cooled UPS from an internally mounted, continuously operating fan. Fan speed must be controlled by the UPS from 50% to 100%. Air intake must be through the front of the unit and exhausted out the rear of the unit.

742G-2.7 Input Converter:

Incoming AC power will be converted to a regulated DC output by the input converter for supplying DC power to the inverter. The input converter will provide input power factor correction and input current distortion reduction.

1. AC Input Current Limit: Provide the input converter with AC input current limiting, whereby the maximum input current is limited to 125% of the full load input current rating.

2. Input Protection: Provide the UPS with built-in protection against under voltage, over current, and overvoltage conditions including low-energy surges introduced on the primary AC source. The UPS can sustain input surges without damage per criteria listed in IEEE C62.41, Category C, Level 3.

3. Battery Recharge: Provide a three-stage battery charger designed to prolong battery life. After a full battery discharge, the battery charger will recharge the batteries to 90% capacity within three (3) hours. Provide DC overvoltage protection so that if the DC voltage exceeds the pre-set limit, the UPS will shut down automatically and the critical load will be transferred to bypass.

742G-2.8 Inverter:

Provide an UPS inverter with a pulse width modulated (PWM) design capable of providing the specified AC output. The inverter must convert DC power from the input converter output or from the battery into precise sinewave AC power for supporting the critical power AC loads.

1. Overload: The inverter shall be capable of supplying current and voltage for overloads exceeding 100% and up to 200% of full load current. A visual indicator and audible alarm indicate overload operation. For greater currents or longer time duration, the inverter has electronic current-limiting protection to prevent damage to components. The inverter is self-protecting against any magnitude of connected output overload. Inverter control logic senses and disconnects the inverter from the critical AC load without the requirement to clear protective devices.

2. Inverter DC Protection: The inverter shall be protected by the following DC shutdown levels.

a. DC Overvoltage Shutdown
b. DC under voltage shutdown (End of discharge)
c. DC under voltage warning (Low battery reserve). The factory default will be set at 2 minutes. This setting is user configurable from 2 to 20 minutes.

3. Output Frequency: The output frequency of the inverter shall be controlled by an oscillator. The inverter will maintain the output frequency to ± 0.1% of nominal frequency during battery mode, frequency converter mode, or when otherwise not synchronized with incoming utility / normal power.

4. Output Protection: The UPS inverter shall employ electronic current limiting circuitry.

5. Battery Over Discharge Protection: To prevent battery damage from over discharging, the UPS control logic controls the shutdown voltage set point. This point is dependent on the rate of discharge and the amount of charge remaining in the battery.

742G-2.9 Display and Controls:

The UPS must be provided with a microprocessor based unit status display, and controls section designed for convenient and reliable user operation. The monitoring functions such as voltage, current, UPS status, and alarm indicators shall be displayed on a full color graphical LCD display. The display must be menu driven navigation and use control buttons for ease of navigation and selection of the configurable parameters.

1. System: The UPS display shall also include LED based system indicators. The system level indicators shall be: Run indicator, and Alarm indicator.

a. The Run indicator LED is green in color and indicates the following:

i. If the LED is on and solid (not blinking) then the UPS is providing output power.
ii. If the LED is blinking, then the inverter is starting.
iii. If the LED off, then the UPS is not providing output power.

b. The UPS Alarm indicator is a multi-color LED indicator to notify the user that a UPS fault condition has occurred.

i. If the LED is yellow, then an alarm has occurred.
ii. If the LED is red, then a fault has occurred.
iii. If the LED is off, then there is no active alarm or fault.

2. Controls: UPS startup and shutdown operations shall be accomplished by using the power button on the front panel of the UPS. The display shall be menu driven navigation and use four control buttons for ease of navigation and selection of the configurable parameters.

a. Control Buttons: The UPS display control button functionality shall be as follows.

i. ESC Button: This button shall return to the previous menu or abort any change before confirming the change.
ii. Up/Left arrow button: This button shall move the cursor up or left, or increase the value displayed when changing parameters. This button will also be used to scroll up for navigating the screens.
iii. Down/Right arrow button: This button will move the cursor down or right, or decrease the value displayed when changing parameters. This button shall also be used to scroll down for navigating the screens.
iv. Enter button: This button shall enter the next level menu or confirm the parameter changes.

b. Display Menu Structure: The UPS display shall have the following menu structure with the following status and configuration screens.

i. UPS Flow Screen (Default screen): The UPS flow screen shall be the default screen after system startup. It shall display an overview screen showing status information, the active (green) power path, and non-working power path (gray). Details in this default screen include operating mode, the input voltage and frequency, output voltage and frequency, battery capacity, estimated battery time remaining, and loading percentage. To prolong the display life, the UPS LCD display will dim and display a screen saver after two minutes of no user interaction if there are no active alarms. Pressing the ENTER shall wake up the display and this action shall not perform any operation. If an alarm or fault occurs, the display shall also wake up the display.
ii. Main Menu: The main menu shall list 6 submenu selections, from left to right, then top to bottom:
    a) Status
    b) Settings
    c) Control
    d) Log
    e) About
    f) Maintenance
iii. Status Menu: The Status screens shall provide the following information.
    a) Input
        L-N Voltage (V)
        L-N current (A)
        Frequency (Hz)
        Power Factor

Energy (kWh)
Input black count (count of input voltage lost)
Input brown count (count of PFC overload to battery)

b) Bypass
   L-N Voltage (V)
   Frequency (Hz)

c) Battery
   Battery status
   Battery voltage (V)
   Battery current (A)
   Backup time (min)
   Remaining capacity (%)
   Discharge count (# of discharges for the battery module)
   Total discharge time (min)
   Battery running time (day)
   Battery replacement time (date of last replacement)
   External battery cabinet group number
   Battery average temp (°C)
   Battery highest temp (°C)
   Battery lowest temp (°C)

d) Output
   L-N Voltage (V)
   L-N current (A)
   Frequency (Hz)
   Energy (kWh)
   Load
   Sout (apparent output power)
   Pout (active output power)
   Power factor
   Load percent (%)
   Time since startup (Days, Hours, Minutes)

3. Settings: The UPS Configuration screens shall provide the following customizable parameters: The default values are listed first.

Output

Voltage selection
Startup on Bypass (Enable/Disable)
Frequency selection (Auto bypass Enable, Auto bypass Disable, 50 Hz no bypass, 60 Hz no bypass)
Bypass voltage upper limit
Bypass voltage lower limit
Run mode (normal mode, or ECO load
ECO voltage range
ECO frequency range
ECO requalification time

Battery

External battery AH
External battery cabinet group No. (0 – 10)
Low battery time
Battery replaced time
Battery periodic test enable
Battery Note duration (month)
Discharge protect time
Equal charge enable
Max charge current
Temperature compensation
Replace battery

4. Monitor

a. Language
b. Date
c. Time
d. Display orientation (Auto rotate, Rack, Tower)
e. Audible alarm (enable, disable)
f. Change settings password

5. System

a. Auto restart
b. Auto restart delay
c. Guaranteed shutdown
d. Start with no battery
e. Remote control
f. Any mode shutdown auto restart enable
g. Output contact NO/NC
h. Input contact NO/NC
i. Dry contact 5 output. (Low battery, On bypass, On battery, UPS fault)
j. Dry contact 6 output. (Low battery, On bypass, On battery, UPS fault)
k. Dry contact 1 output. (Low battery, On bypass, On battery, UPS fault)
l. Dry contact 2 output. (Low battery, On bypass, On battery, UPS fault)
m. Sleep mode
n. IT system compatibility
o. Outlet Parameter Options
p. Apply same settings across outlets
q. Turn on Outlet
r. Turn on Delay
s. Outlet Settings based on discharging time
t. Threshold of turning off the outlet
u. Turn on when power returns
v. Outlet settings based on capacity
w. Threshold of turning off the outlet
x. Turn on when power returns

6. Control: The UPS shall have the following controls from the display.

a. UPS On/Off/Bypass
b. Turn UPS On
c. Turn UPS Off
d. Turn on Bypass (manually transfer to bypass power)
e. Audible Alarm
f. Turn audible alarm On (test alarm)
g. Turn audible alarm Off (alarm silence)
h. Battery test
i. Start battery self test
j. Clear faults
k. Reset power statistics

7. Log: The UPS shall have an event log to record 255 events and shall be viewable from the display.

a. View Log
b. Navigate the event log to view the last 255 events
c. Clear Log
d. Once the event log is full, the controller will begin replacing the first event logged to provide a FIFO process for maintaining event history. The event history shall record and display the number of events out of the 255, as well as the time from when viewing the event, and the event that occurred.

8. About: The UPS shall have an About screen to display the UPS model number, serial number, time since startup, hardware version, and firmware version.

9. Maintenance: The UPS shall have the ability to display the network information of the RDU101 SNMP/webcard when installed. The information available shall be MAC address and IP address.

10. Automatic Battery Test: The UPS shall feature an automatic battery test with the factory default test interval set at every 8 weeks. The battery test shall ensure the capability of the battery to supply power to the inverter while loaded. If the battery fails the test, the UPS shall display a warning message to indicate the internal batteries need to be replaced. The automatic battery test feature shall be capable of being disabled or configured to operate every 8, 12, 16, 20 or 26 weeks through the UPS Configuration Program or from the LCD display.

742G-2.10 Bypass:

Provide a bypass circuit as an integral part of the UPS.

1. UPS 5KVA: Provide double pole device which includes a make-before-break transfer, and provide a maximum detect and transfer time of 4-6 milli-seconds. Design the bypass circuit to ensure the simultaneous transfer of the L1 and L2 poles. Configure the bypass to wrap around the PFC converter, battery charger, DC-DC converter, inverter, and battery. Use the rear panel mounted UPS input circuit breaker for the bypass circuit and route bypass power through the UPS input filters and surge suppression circuit. The bypass circuit default position must be in the Bypass mode (utility).

2. UPS 2KVA: Provide bypass control logic which contains an automatic transfer control circuit that senses the status of the inverter logic signals and operating and alarm conditions. Configure the bypass control circuit to provide a transfer of the load to the bypass source if available and if the inverter is capable of powering the load (i.e. if there is an overload condition, if the unit is in manual bypass source, or if the voltage or frequency is out of tolerance).

3. Automatic Transfers: Activate the bypass automatically with the transfer control logic, transferring the critical AC load to the bypass source, after the transfer logic senses one of the following conditions:

a. UPS Overload
b. UPS over temperature
c. PFC failure
d. Inverter failure
e. DC bus overvoltage

i. Once the overload condition is reduced, the load shall automatically be transferred back to inverter power.
ii. UPS 5KVA: An over temperature requires manual transfer back to inverter power after cooling.

742G-2.11 Internal Battery:

Use a valve regulated, non-spillable, lead acid cells (VRLA) as a stored energy source for the specified UPS system. House the battery internal to the UPS cabinet, and size to support the inverter at rated load and power factor, with an ambient temperature of 25 °C (77 °F) for a minimum of 3 minutes reserve time. The expected life of the battery shall be 3 – 5 years or a minimum 260 complete discharge cycles. Ensure that the UPS battery can be replaced easily by the owner/operator. The UPS will allow connections for up to 10 external battery cabinets to provide extended run time. The internal battery must be user replaceable and includes a blind-mate style connector located on the rear of the battery kit. The expected life of the battery must be 3-5 years or a minimum 260 complete discharge cycles.

742G-2.12 Optional External Battery Cabinet:

UPS 5KVA: The UPS shall allow for connecting of up to six external battery cabinets to provide extended run time.

742G-2.13 Output Distribution:

Output distribution requirements for each UPS located in an OCC is as follows:

1. UPS 5KVA - Output power will be 120/240 Volts, AC, single-phase, 60 Hz, 3 wire, plus ground. Output power from the UPS will be distributed by a hard wired feeder circuit (L1, L2, N, G) routed underground to the RTC.

2. UPS 2KVA - Output Distribution shall be integral to the UPS and located on the rear of the unit. The UPS unit will have four (4) programmable 120 Volt, NEMA 5-20R, simplex receptacle outlets that can be controlled/programmed on/off individually. The UPS unit will also have one (1) 120 Volt, NEMA L5-20R, simplex receptacle that is not programmable and is energized when the UPS is operating normally.

742G-2.14 Communications:

Communications requirements for each UPS located in an OCC must be in accordance with the following:

UPS". Ensure the communications cable is routed between the UPS and the Department's managed network switch (Brocade switch) within the OCC. Network communication cables for each UPS is as follows:

a. UPS 5KVA - Install a category 6 cable, 4 pair, copper UTP, CMP rated, network communication cable with RJ45 connectors.

b. UPS 2KVA - . Install a category 6 cable, 4 pair, copper UTP, CMP rated, network communication cable with RJ45 connectors.

2. Intellislot Relay Interface Card: The optional Intellislot Relay Interface Card shall provide contact closure for remote monitoring of alarm conditions in the UPS. Contacts are available for On battery, On bypass, Low battery, Summary alarm, UPS on fault, and On UPS. The contacts will be rated for 24 VAC or 24 VDC at 1 Amp. Connections shall be to a terminal block connector with a cable provided by the end user.

3. Terminal Block Connections: The UPS shall be equipped with a terminal block located on the rear panel to provide low voltage signals for On battery, Low battery, Any-mode shutdown, and Battery mode shutdown.

4. Any-Mode Shutdown: The purpose of Any-Mode Shutdown will be to shut down the UPS output by turning off the rectifier, inverter, and bypass so that there is no output power to the electrical loads. Any mode shutdown can be operated locally and remotely, as described below.

a. Local Any-mode shutdown can be entered from the battery mode shutdown device on the back of the unit.

b. Remote Any-mode shutdown can be initiated by a battery mode shutdown button mounted at a remote location.

5. Remote Power Off shall be performed by either NO or NC contacts of Any-mode shutdown, depending on the settings in the configuration program. A current limited source (+ 12 VDC, 50 milli-Amps) shall be available from the UPS. The connection to the UPS for remote power off shall be by a terminal block connector.

6. Battery Mode Shutdown: Battery mode shutdown shall permit shutting down the UPS by turning off the rectifier, inverter, and bypass so that there is no output power to the electrical loads when the UPS is on battery. Battery mode shutdown shall be able to be performed locally and remotely. The battery mode shutdown signal will not cause an immediate shutdown, it will instead start a 2 minute shutdown timer. This timer can not be stopped once it is triggered. If normal utility power returns during the count down timer, then the UPS will still shut down, and

must remain shut down for 10 seconds. The auto-restart setting will then dictate whether the UPS turns back On when normal utility power is restored.

7. USB Port: A USB communications port (Version 2.0) shall be provided on the rear of the UPS, and shall meet the HID Power Device standard, version 1.0 or later. All models must work with the Power Management system in Microsoft® Windows® 11 or later. They must also support the equivalent functions in Linux, and Mac OSX®

8. Serial Port: A serial port (RS-232) with an RJ-45 connector will be provided on the rear of the UPS. This will allow for command line interface.

T742G-3 Shop Drawings and Submittals.

1. Submit plan views and elevation views of each UPS cabinet with overall dimensions and clearances required for maintenance procedures. Provide heat output and cooling air requirements.

2. The specified UPS system will be supplied with Safety Instructions, Warning Sheet, WEEE recycling sheet (ISO 14001 compliance), a printed copy of the Quick Start Guide, and a printed copy of the factory test report.

3. The User Manual will be downloaded from the manufacturer's web site. The User Manual will include installation drawings and instructions, a functional description of the equipment with block diagrams, safety precautions, illustrations, step by step operating procedures, and routine maintenance guidelines.

4. A warranty statement and repair parts availability statement will be submitted to the department.

T742G-4 Replacement Parts.

Replacement parts will available through a local distributor within 100 miles of the job site. The replacement parts including power modules and battery modules for the UPS model installed at the job site will be available 24 hours a day, 7 days a week, 365 days a year.

T742G-5 Quality Assurance.

1. Manufacturers Qualifications: Minimum of ten years experience in the design, manufacture, and testing of solid-state UPS systems is required. The manufacturer shall be certified to ISO 9001.

2. Factory Testing: Before shipment, the manufacturer fully and completely tests the system to assure compliance with the specification. These tests include operational discharge and recharge tests on the internal battery to guarantee rated performance.

742G-5.1 Fabrication:

All materials and components used to manufacture the UPS will be new, of current manufacture, and not in prior service except as required during factory testing. The UPS is constructed of replaceable subassemblies. All active electronic devices are solid-state. All relays must be provided with dust covers.

742G-5.2 Wiring:

Wiring practices, materials and coding must be in accordance with the requirements of the standards listed in Section 2.1 above and other applicable codes and standards. All wiring must be copper.

T742G-6 Installation.

Install UPS assemblies in accordance with the manufacturer's recommendations. Include a UPS operation and maintenance manual in the cabinet where the UPS is installed that includes cabinet wiring schematics, electrical interconnection drawings, parts layout and parts lists.

T742G-7 Testing.

The following inspections and test procedures will be performed by factory trained field service personnel during the UPS start-up and commissioning

742G-7.1 Visual Inspection:

1. Inspect equipment for signs of shipping or installation damage.
2. Verify installation per drawings.
3. Inspect cabinets for foreign objects.

742G-7.2 B. Mechanical Inspection:

1. Check all power modules are correctly fitted.
2. Check all battery modules are correctly fitted.
3. Check all terminal screws, nuts, and/or spade lugs for tightness.

742G-7.3 C Electrical Inspection:

1. Confirm that the input voltage and phase rotation is correct.
2. Verify that the input and output receptacles and connections or not damaged.

T742G-8 Warranty.

Provide warranties in accordance with Section 685-5 and the following:

Shipping charges for repair parts during the warranty period will not be charged to the Department.

The UPS manufacturer shall provide a written warranty statement to the department that states: "During the warranty period a factory trained service technician will be dispatched and arrive at the site where the UPS is located within 4 hours of receiving a request for service by the Department."

The warranty and the written warranty statement shall be included in the shop drawings.

T742G-9 Method of Measurement.

The UPS 2 KVA and 5 KVA will not be measured separately and will be included in the pay item for the OCC.

T742G-10 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T745
SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

T745-1 Description.

Furnish all labor and materials necessary to provide, install and test a Supervisory Control and Data Acquisition System at each toll site.

T745-2 Materials.

T745-2.1 SCADA System: must meet the following applicable industry standards:

1. FCC rules, part 15 – Limits for a Class A digital device.
2. IEEE C62.41 - Guide on Surge Voltages in AC Power Circuits Rated up to 600V.
3. MODBUS over serial line specifications and implementation guide V1.0.
4. UL requirements throughout document include UL or other National Recognized Testing Laboratory (NRTL) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA) under the requirements of 29CFR1910.7.

Provide a SCADA system at each toll site consisting of a SCADA Control Panel (SCP) to monitor various parameters and conditions associated with the toll site:

1. Electrical distribution system
2. Emergency generator
3. ATS
4. Fuel tank
5. TEB or Cabinet AC systems
6. RTC enclosure(s)
7. OCC enclosure
8. Power panel

Provide analog sensors, monitors, and position indicating contacts installed in the equipment or in the enclosures to provide inputs to the SCADA control panel. The remote sensors, monitors and components will be connected to the SCADA control panel with communication cables in raceways to form a complete system.

A technician from Florida's Turnpike Enterprise will load the final programming at the SCADA control panel for final acceptance and commissioning tests.

Provide conduit and cabling in accordance with the SCADA Diagram included in the Plans.

The SCADA Control Panel must be manufactured by a UL508 Panel fabrication shop.

The SCADA Control Panel must use IEEE 802.3u, 100 Mbps, Fast Ethernet protocol to communicate with the Department's managed network switch.

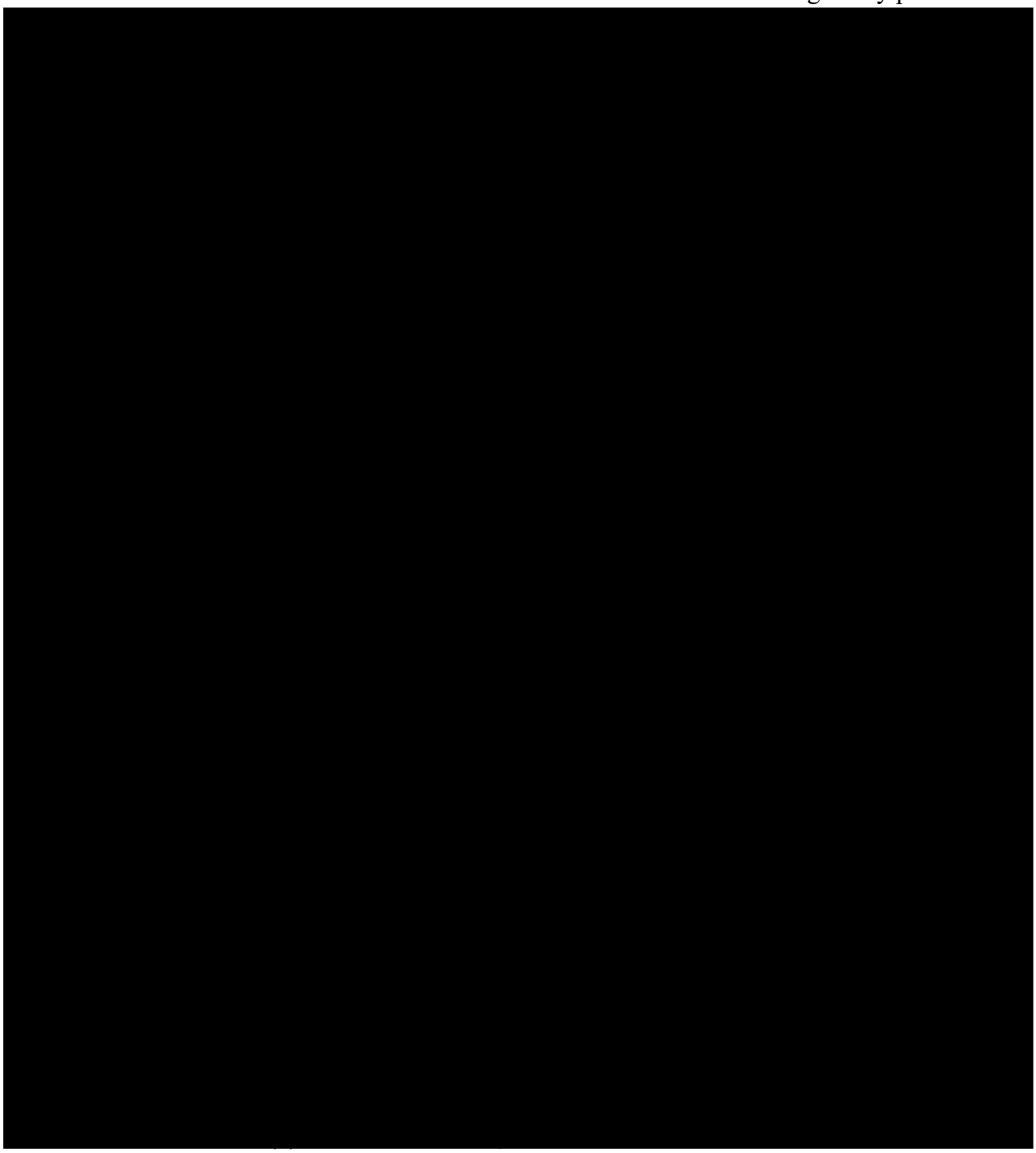
Some equipment, such as the UPS units, will send information indirectly to the SCADA system.

T745-2.2 Power Distribution Frame Monitoring Equipment: Furnish and install the equipment monitored by the SCADA system and the associated monitoring equipment located on the power distribution frames. Power distribution frame monitoring cables must communicate back to the SCADA Control Panel in the OCC via the PLC located in the Power Meters Enclosure (PMs) for toll facilities with on-site power. Power distribution frames at toll

facilities with off-site power will interface directly with the SCADA Control Panel since a Power Meters Enclosure will not be present.

T745-2.2.1 Main Circuit Breaker: The position of the main circuit breaker will be monitored at the first service disconnect by using auxiliary dry contacts on the circuit breaker. The auxiliary contacts will be open when the circuit breaker is open and closed when the circuit breaker is closed. A 24 VDC signal from the SCADA control panel will be routed through the auxiliary contacts.

T745-2.2.2 SCADA Power Meters Enclosure: The incoming utility power and



T745-2.2.3 Emergency Generator: The emergency generator electrical and mechanical parameters will be monitored by the SCADA Power Meters Enclosure. The emergency generator controller will communicate with the SCADA system by using a MODBUS RTU serial communications protocol.

1. The emergency generator circuit breaker position will be monitored by using auxiliary contacts on the generator circuit breaker. The auxiliary contacts will be open when the circuit breaker is open and closed when the circuit breaker is closed. A 24 VDC signal from the SCADA control panel will be routed through the auxiliary contacts.

2. A control relay in the SCADA control panel will be capable of remotely starting and stopping the emergency generator.

T745-2.2.4 Automatic Transfer Switch: The position of the Automatic Transfer Switch (ATS) will be monitored by AB, NO/NC auxiliary dry contacts within the ATS. The A contact will be closed when the ATS is in the Normal position and the B contact will be open the ATS is in the Normal position. The AB contacts will change state when the ATS moves to the Emergency position. A 24 VDC signal from the SCADA Power Meters Enclosure will be routed through the auxiliary contacts.

1. Field install Class B current transformers (CT's) in the ATS to measure the current in the emergency generator feeder. Ensure the CT's secondary current output is 0 to 5 Amps, and install a CT shorting block model #CTSB-10. Connect the CT's current sensing leads to the power meter (PM-G) located on the SCADA Power Meters Enclosure.

2. Field install voltage sensing leads in the ATS to measure the voltage in the emergency generator feeder. Install a fused voltage sensing terminal block Schneider model # VTFB-6 with 1 Amp fuses. Connect the voltage sensing leads to the power meter (PM-G) located on the SCADA Power Meters Enclosure.

T745-2.2.5 SPDs: The alarm contacts on the surge suppression devices at the Automatic Transfer Switch (ATS), emergency distribution panel (EDP), and Emergency Panelboard (EP1) will be monitored by the SCADA system.

T745-2.2.6 AC Units: The branch circuit current for each AC unit in the RTCs [redacted]

T745-2.3 RTC Cabinet Monitoring: Furnish the RTC SCADA components and associated monitoring equipment and turn over to the Engineer. Furnish the following:

T745-2.3.1 RTC SCADA Module: Each RTC will contain a [redacted]

T745-2.3.2 Doors: The door positions for each RTC will be monitored by DPDT door position dry contact tamper switches. The door tamper switches contacts will be open when the door(s) are open and closed when the door(s) are closed.

T745-2.3.3 AC Units: The RTC air conditioning units will be continuously monitored by the SCADA System. The operating information and alarms will be transmitted to the SCADA System on a two conductor, 18 AWG, stranded, tinned copper, overall foil shielding cable that has a PVC outer jacket.

T745-2.3.4 Leak Detector: A leak detector will monitor the bottom of the [redacted]

T745-2.4 OCC Monitoring: Furnish and install the equipment monitored by the SCADA System and the associated monitoring equipment located the OCC Cabinets. All cabling for power and data that serve each RTC that emanate from the OCC must be terminated in the OCC and be coiled at a length equal to the length of the conduit between the OCC and each RTC plus twenty feet of slack. Furnish and install the following:

T745-2.4.1 SCADA Control Panel: Each OCC will contain a [redacted]

[redacted]

T745-2.4.2 AC Units: The OCC air conditioning units will be continuously monitored by the SCADA System. The operating information and alarms will be transmitted to the SCADA System on a two conductor, 18 AWG, stranded, tinned copper, overall foil shielding cable that has a PVC outer jacket.

T745-2.4.3 Doors: The door positions for each OCC will be monitored by DBDT door position dry contact tamper switches. The door tamper switches contacts will be open when the door(s) are open and closed when the door(s) are closed.

T745-2.4.4 UPS: The uninterruptible power supply (UPS) unit(s) will be monitored using Network Interface Cards (NIC). The NIC card(s) will be factory provided and will communicate with Department's network switch using the 10Base T Ethernet protocol.

T745-2.4.5 SCADA Control Panel AC Input: A control power circuit will be installed for the SCADA control panel. The branch circuit will be a 120 VAC, 20 Amp circuit that originates from the UPS inside the OCC.

T745-2.4.6 Leak Detector: A leak detector will monitor the bottom of the

[redacted]

T745-3 Submittals and Shop Drawings.

Submit shop drawings in accordance with Section 5, General Requirements for Toll Site Electrical Infrastructure, and the following:

1. A separate set of shop drawings must be submitted for each SCADA system at each site. Each set of shop drawings associated with each site will show the unique name of the

RTC site in the title blocks. Typical information associated with multiple sites will be rejected for insufficient information.

2. Include the following information in each set of SCADA shop drawings.

Hardware Product Information Submittal: Hardware product information must include, but not be limited to: catalog cut sheets, data sheets, performance surveys, test reports, equipment lists, material list, diagrams, pictures, and descriptive material. The product information must cover all items including mechanical devices, mounting components, wiring, terminal strips, connectors, accessories, and spare parts. The submittal information must show the standard and optional product features, as well as all performance data and specifications.

3. Prior to commencement of manufacture (or shipment for stock items), the SCADA System Provider must submit for review product information for all equipment and material specified in this Section. Include specification sheets on each remote sensor, power meter, or interface card that will communicate or provide status to the SCADA system.

4. Connection Diagrams

a. Show the placement, labeling and wiring of components within panels, cabinets, and consoles. Wire lists and wireless diagrams will not be accepted. Components must be shown arranged in the physical layout (not necessarily to scale), as it would appear to a person servicing the equipment. Wiring designations, and routing designations, will follow the projects drawings standards. The connection diagrams will be submitted on 11" x 17" paper.

b. The SCADA System Provider will submit connection diagrams for all new panels, cabinets, and consoles Loop diagrams may not be substituted for connection diagrams.

5. Interconnection Diagrams

a. Interconnection diagrams will be site specific and will show the external wiring between terminals of associated equipment, control panels, motor control centers, terminal boxes, field switches, field sensors, meters, critical power panels, and any other device, panel, or enclosure. Interconnection diagrams must clearly depict all cable types, conductors, and cable tags. Cable tagging must conform to project standards.

b. The SCADA System Provider must prepare and submit interconnection diagrams for all major system components.

6. Panel Fabrication and Layout Drawings (PLFD)

a. As a minimum, PLFD will include front, back, and section views; the locations of all mounted components; drawing scale; nameplate engraving schedule; and structural materials and supports. A bill of material will also be provided on the drawing, or as a separate document. All drawings will be scaled. Overall dimensions and minimum clearances must be shown. Sufficient detail must be included to demonstrate material choices, outward appearance, construction methods, and seismic force resistance.

b. Complete shop drawings will be submitted for all panels, cabinets, and consoles which are fabricated, or modified, for this project. Reviewers will have the right to make modifications to the interior and exterior layouts of panels as part of the shop drawing review. No additional compensation will be provided to the SCADA System Provider for changes. The SCADA System Provider will budget for one redesign of the panel layout to incorporate the reviewers' changes..

T745-4 Warranty.

The manufacturer will warrant all components against defects in materials and

workmanship for two years. The warranty will cover all parts for two years and onsite labor for two years.

T745-4.1 Quality Assurance

1. Control Panel Integrator Qualifications
2. Minimum of ten years' experience in the design, manufacture, and testing of solid-state PLC systems is required.
3. FACTORY TESTING
4. Before shipment, the manufacturer fully and completely tests the system to assure compliance with the specification.

T745-4.2 Products submitted other than listed part numbers are the responsibility of the contractor for system integration and revised PLC programming to make any substitute product integrate into the SCADA system.

T745-5 Construction Requirements.

T745-5.1 Fabrication: All materials and components making up the SCADA system will be new, of current design, and not in prior service except as required during factory testing. The SCADA system will be constructed of replaceable subassemblies.

T745-5.2 Wiring: Wiring practices, materials, and coding will be in accordance with the requirements of the National Electrical Code (NFPA 70) and the National Electrical Manufacturer Association.

Cables with shields and/or drain wires will have the shield and/or drain wire grounded at the SCADA control panel end only.

Each cable or conductor installed for the SCADA system will be field labeled at both ends of the cable or conductor. Labels will be installed within 6 inches of the ends of each cable or conductor. Ensure the labels are self-laminating and the label material is vinyl with white matte finish and black 12-point text that is heat and solvent resistant. Contact the Tolls Engineering Department for wire naming conventions and label syntax.

Wiring inside the SCADA control cabinet will be routed through PVC wide finger wiring ducts. The white wiring ducts will have removable covers. The wiring duct will be equal to Panduit, Type G wide finger wiring duct.

T745-5.3 Field Quality Control:

Upon completion of the work, test the installation to ensure that the installation is entirely free of ground faults, short circuits, and open circuits and that it is in satisfactory working condition. Furnish all labor, materials, and apparatus necessary for making the required tests.

Remove and replace any defective material or workmanship discovered as a result of these tests at no expense to the Department and make subsequent re-tests to the satisfaction of the Engineer.

The following inspections and test procedures will be performed by trained field service personnel during the SCADA system start-up and commissioning:

1. Visual Inspections
    a. Inspect equipment for signs of shipping or installation damage.
    b. Verify installation per drawings.
    c. Inspect cabinets for foreign objects.
2. Mechanical Inspections
    a. Check all I/O modules are correctly fitted.

b. Check all power supply modules are correctly fitted.

c. Check all terminal screws, nuts, and/or spade lugs for tightness.

3. Electrical Inspections

a. Confirm input voltage is correct.

b. Confirm each remote sensor, meter, and interface card is functioning correctly.

4. Install and/or test the following items before notifying the Department that the SCADA system is ready to be programmed:

a. SCADA system control panel installed and energized.

b. The tolling communications cabinet is installed.

c. The power serving the OCC is energized.

d. Testing of the OCC fiber optic cables in accordance with specifications 633 – Intelligent Transportations Systems - Fiber Optic Cable Interconnect, has been completed satisfactorily.

e. Network switch is installed and energized.

T745-5.4 Replacement Parts Stocking:

Replacement parts must be available through a local distributor within 100 miles of the job site. The parts and materials within the SCADA control cabinet must be available 24 hours a day, 7 days a week, 365 days a year from a local distributor. Include the local distributors name on the shop drawings.

T745-6 Basis of Payment.

The work specified in this Section will not be paid for directly but will be considered as incidental work.

TECHNICAL SPECIAL PROVISION

FOR

OUTDOOR COMMUNICATIONS CABINETS

FINANCIAL PROJECT NO.: _____-_-__-__

This item has been digitally signed and sealed by _____ on the date adjacent to the seal. Printed copies of this document are not considered signed and sealed and the signature must be verified on any electronic copies.

Date: _____
Fla. License No.: _____
Firm Name: _____
Firm Address: _____
City, State, Zip Code: _____

SECTION T746
OUTDOOR COMMUNICATIONS CABINETS

T746-1 Description.

Furnish and install RTC Toll Site Outdoor Communications Cabinets along with the required accessories as shown in the Plans.

T746-2 Materials.

Provide UL or other NRTL Listed NEMA 3R 316 stainless steel enclosure and the following:

1. Cabinet with an open bottom. Louvers and vents are not permitted
2. Single front and rear access doors - Gasketed doors with continuous hinge held closed by 3-point latching mechanism with door stop kits
3. Enclosure lighting activated by door open/close
4. Cabinet must be structurally designed to comply with FBC requirements for Risk Category II buildings and structures. Wind loads for the cabinet used in structural calculations must be the 3-second wind velocity (gusts) per FBC Section 1620 “High Velocity Zones - Wind Loads” for Miami-Dade County.
5. Cabinet must have a means of bonding, such as a lug, to the site grounding system
6. Cabinet must be installed on a minimum 3” high open base /riser/pedestal
7. Sunshields constructed of the same material and gauge metal as the cabinet, covering all exposed sides of the enclosure with 1” standoff separators
8. Full length EIA-310 compliant 19-inch rack rails for mounting equipment in the front and back. Cabinet must have a minimum 36 usable rack units (RU) available vertically. All mounting rails to be configured as square hole cage nut type 12-24 Black
9. Slide out shelf occupying 1RU
10. Two (2) sets of Equipment Support Brackets or a 4-post rack unit frame
11. Three (3) sets of 3-inch Horizontal Wire Management
12. [redacted]
13. One (1) UPS for the OCC components furnished and installed
14. One (1) UPS for each RTC furnished and installed
15. Fiber Distribution Panel (Fiber Patch Panel)
16. Include the following wiring devices in each OCC:
    a. Two (2) 15A simplex receptacles for dedicated use of the AC units each with a NEMA type matching the plug from the AC units
    b. One (1) 20A NEMA 5-20R receptacle for convenience power
    c. One (1) 20A NEMA L5-20R receptacle for the OCC UPS
17. One (1) vertical Power Distribution Unit (PDU) furnished and installed
    a. PDU shall be single phase monitored, surge protected
    b. PDU shall be NEMA 5-20R compliant and have a minimum of (12) NEMA 5-20R, standard simplex outlets
    c. The PDU input power cord must come factory installed from the manufacturer with L5-20P plug (field retrofitted cords will not be accepted)
    d. PDU shall be vertically mounted directly to the OCC using mounting hardware or tool-less feature

T746-2.2 Air Conditioner Units: Provide two (2) factory-installed side-mounted AC units each at 230V, 1-phase. Unit, size, make and model must be as indicated on the Plans. Shop-mount each unit on different sides of the enclosure (never on the same side or on the front or back).

T746-2.3 Fiber Distribution Panel (FDP): Provide Fiber Distribution Panel (FDP) in accordance with the following:

1. Manufacturers Provide a product from one of the following, or approved equal, meeting the requirements in the contract documents:

a. LEVITON OPT-X 2000i SDX 2RU Rack Mount Enclosures with four (4) SDX adapter plates (5F100-2LC), OS2 fiber type, SC duplex adapter type with pre-terminated pigtails, four (4) splice trays (heat shrink, plastic holders 12 fibers), and cable clamp kit. Accessories include cable strain relief kit and fiber management ring kit.

b. CORNING CCH-02U closet connector housing, two rack units, supplied with four pre-terminated CCH pigtail splice cassettes (CCH-CS12-59-P00RE)

2. 19"-EIA width rack mountable, FDP(s) suitable for loose tube, single or ribbon fiber optic cables housed inside of the communications cabinet.

3. Provide one (1) FDP be provided per lateral fiber drop, or interconnect, with the following features:

a. One (1) fiber distribution and splice enclosure must occupy 2RU, and must accommodate at least four (4) Pre-terminated splice cassette /pigtail splice modules / splice trays, as supplied by the FDP manufacturer for the make and model of the FDP.

b. Slide out tray

c. See through, removable top cover

d. Removable tinted polycarbonate front door

e. Strain relief brackets, routing clips and guides

f. Mounting brackets for proper installation

4. Each pre-terminated cassette, pigtail splice module / splice tray must be in accordance with the following:

a. Six (6) SC/UPC duplex, single-mode, ceramic insert composite ports

b. Twelve (12) single mode factory polished pre-terminated pigtails

c. Twelve (12) single fiber heat-shrink splice protectors

d. Protective braided tubing for incoming cable

e. Grommets and cable ties for additional strain relief

f. Mounting hardware for use with the fiber optic distribution panel (FDP)

5. Provide (12) single mode SC to SC jumpers for each set of two FOC buffers entering an OCC with the length necessary to patch through all lateral fibers color-to-color.

6. The FDP must be mounted at the position next below the top cable management position within the OCC.

7. The number of fiber ports must comply with the number of strands per cable sheath being dropped to the toll equipment building.

8. Provide adjustable front and rear equipment mounting rails to properly mount the FDP. The mounting rails must be square hole cage nut with #12-24 hardware.

T746-3 Submittals and Shop Drawings.

T746-3.1 Calculations and Shop Drawings: Submit shop drawings in accordance with Section 5 and General Requirements for Toll Site Electrical Infrastructure for cabinet installation on pad. Submittal of shop drawings must include manufacturer's installation manual. Substitutions that are different than the basis of design for the cabinet and / or AC units provide supporting materials to show equivalency as identified in General Requirements for Toll Site Electrical Infrastructure. Confirm that each AC unit can independently maintain the temperature within the cabinet.

T746-3.2 Data Sheets: Provide data sheets for the cabinet and all accessories, din rail, cable management, Fiber Distribution Panel, UPS, SCADA and all associated components.

T746-4 Warranty.

The OCC, AC units and lighting under this specification section will be warranted by the manufacturer against defects in material and workmanship for a period of 1 year from the date of acceptance. The warranty will include parts, shipping costs, rigging costs, labor, and travel expenses, to replace the equipment or repair the equipment in place, in accordance with the manufacturers published service manuals.

Warranty for the individual components in the OCC will be in accordance with the specification section for each component.

T746-5 Construction Requirements.

The communications cabinets must be properly bonded and grounded to the existing or new grounding system.

T746-5.1 OCC: The OCC must be mounted securely to the toll equipment pad in accordance with the plans and approved shop drawings.

1. Install in accordance with NECA "Standard of Installation".
2. Install enclosures and boxes plumb.
3. Install cabinet fronts plumb.
4. Use the factory mounting holes to secure and support cabinets and enclosures. Do not field drill mounting holes.

T746-5.2 Cleaning and Testing: The completed OCC assembly (enclosure, penetrations, AC and all associated elements) must be subjected to a hose-down water test in the field to confirm that the entire assembly conforms to NEMA 3RX standards and is at a minimum waterproof. The hose-down water test must be executed after the enclosure and all its associated elements have been constructed on site and with the Department and the CEI present to witness the test. This test must occur during the primary walk-through. Water must be directly hosed on all areas susceptible to water intrusion, such as the exterior interface between the AC units and the enclosure, interior interface between the AC units and the enclosure (hose water through/inside the cooling unit), around all doors, penetrations (conduit/wireway/etc.), and any other areas that were factory or field cut, welded, or sealed. If there is water intrusion in any water amount or any indication thereof, the OCC enclosure assembly will not be accepted.

Cleaning of the cabinet and all installed accessories must be in accordance with Acceptance Procedures for Toll Facilities and the following:

1. Clean electrical parts to remove conductive and harmful materials.
2. Remove dirt and debris from enclosure.

3. Clean finishes and touch up damage.

T746-6 Method of Measurement.

The Contract unit price for each OCC, furnished and installed, will include furnishing, placement, and testing of the cabinet, all its components, systems, materials, equipment, accessories, and for all tools, labor, equipment, hardware, supplies, shop drawings, utility connections, grounding and bonding for OCC and RTC Cabinets, documentation, associated surge protection devices, SCADA system components, uninterruptable power supply(ies), AC units with dry well(s), wiring devices associated with OCC and RTC Cabinets, lightning protection system associated with OCC and RTC Cabinets, identification of electrical systems associated with OCC and RTC Cabinets, and incidentals necessary to complete the work. The cost of the Acceptance Procedures for Toll Facilities at each RTC toll site location and general requirements for toll facilities electrical infrastructure associated with OCC and RTC Cabinets must also be included in the cost of the OCC.

T746-7 Basis of Payment.

Price and payment will be full compensation for all work specified in this Section. Payment will be made under:

Item No. 676-2-810 Outdoor Communications Cabinet, Furnish & Install, Toll Site - Each.