

282 Toll Site Design and Layout

282.1 Toll Site Design

282.1.1 General Requirements

Toll facility site plans must be coordinated with all other drawings and component sets. Toll site design restrictions include:

- (1) **RTC Sites:** RTCs can only be utilized for up to five (5) equipped lanes and shoulders per tolling movement. Each RTC can support only one tolling movement. See **FDM 280.7.2** for use of RTC toll sites and associated criteria.
- (2) **TEB Sites:** TEBs are required for mainline toll sites with TLs and all toll sites where an RTC Cabinet design is not feasible. See **FDM 283.3.1** for maximum lane requirements.

282.1.2 Infrastructure Placement

The following infrastructure that interferes with toll equipment operations must not be located at or near a toll site:

- (1) Electromagnetic field emitting sources must be located at least 5 feet from the toll site envelope and loop infrastructure.
- (2) Except for gantry mounted power conductors and secondary power conductors for the toll facility electrical service, low voltage power lines (120/240 V or 480V) AC or DC power must be located at least 5 feet from the toll site envelope. This includes roadway light poles, conduits, conductors, etc.
- (3) Low voltage circuits (120/240 V or 480V) AC or DC power must be located at least 5 feet from the loop conduit(s).
- (4) Pipes carrying or intending to convey fluids must be located at least 10 feet from the toll site envelope and at least 5 feet from the loop conduit(s).
- (5) Existing and proposed utilities, mechanically stabilized earth (MSE) metallic wall straps, drainage structures, box culverts, or bridge foundations must be located at least 5 feet from the toll site envelope.
- (6) When MSE walls with non-metallic wall straps are proposed, these wall plans must require that strap layout and associated slabs must not conflict with toll site infrastructure (conduits and foundations).

- (7) Walls and wall foundations with metallic reinforcement must not be located within the toll site envelope.

282.1.3 High Voltage Circuits

- (1) Overhead circuits or conductors that operate at high voltage (> 600VAC RMS or VDC) must be located at least 200 feet from the toll site envelope.
- (2) If existing high voltage lines are unavoidable within 200 feet of a proposed toll site envelope, provide the following information for Turnpike Tolls Design to evaluate the site for toll system interference:
 - (a) The line's voltage and location relative to the toll site.
 - (b) The northing and easting of all four corners of the toll loop pavement area.

282.1.4 Wireless Communication Devices

- (1) Toll sites must be located at least 500 feet from any devices operating within the 902 MHz to 928 MHz frequency band.
- (2) If there is existing FDOT equipment, such as travel time system readers, operating in the ISM/LMS Frequency Band 902MHz-928MHZ within 1 mile of an existing or proposed toll site, develop a remediation approach in conjunction with Turnpike Tolls Design. Include the identified remediation in the plans.
- (3) ISM/LMS Frequency Band 902MHz-928MHZ wireless two-way communication devices licensed or unlicensed (Spread Spectrum) emitters are not permitted within any distance in which the referenced emitter produces an in-band signal interference level greater than -68dBm at the input to the toll site gantry antennas.

282.1.5 Existing Toll Sites

New toll sites must be located such that existing toll facilities continue to operate until the new toll sites are commissioned and collecting tolls.

282.1.5.1 General Requirements

See **FDM 281.4.1** for additional requirements for scheduling of existing toll site demolition.

282.1.5.2 Building Demolition Plans and Permits

- (1) Demolition permits are required for each location and must be separate from building permits required for new, modified, and renovated buildings.
- (2) All building roof systems identified to remain must be protected from damage and water intrusion caused by required demolition and any additional new work to retain roof integrity and warranty.
- (3) Repairs to existing roof systems must be accomplished by using materials of the original system and repair procedures as required by the original roof system manufacturer and performed by an authorized roof system installer.
- (4) All total demolition, selective demolition, and renovation activities must consider results of asbestos and/or paint testing reports.
- (5) Dispose all hazardous materials per all applicable State and hazardous materials handling guidelines.

282.1.5.3 Salvage and Disposal

Coordinate with the Turnpike Toll Systems Project Manager for identifying:

- (1) All items that are desired to be salvaged and identified as such in the contract documents.
 - (a) All existing fire extinguishers and brackets must be returned to the Turnpike for all buildings to be demolished.
 - (b) All flag poles and associated up lighting must be removed. Flags must be returned to the Turnpike.
 - (c) Other equipment to be salvaged and returned to the Turnpike.
- (2) Existing equipment to be salvaged by the Turnpike.
 - (a) Salvage of existing equipment may be required at non-AET toll sites, TEB sites, and at RTC sites.
 - (b) Traffic control phasing must include time for salvage.
 - (c) Salvage of existing equipment includes equipment located on the gantry. Equipment removal/salvage will require coordination with the traffic phasing.

282.1.5.4 Proposed Infrastructure with Potential Frequency Interference Near Existing Toll Sites

New infrastructure not related to toll equipment, that operates within the 902 MHz to 928 MHz frequency band must be located at least 1,000 feet from existing toll sites.

282.2 Toll Site Layout

282.2.1 General Requirements

- (1) Unless otherwise noted, all new toll sites must comply with the site elements, layout, and detailing of the typical site plans in their entirety. Typical site plan layouts are shown in:
 - (a) **TEB Site Plans:** *Exhibit 282-1, Exhibit 282-2, Exhibit 282-3, Exhibit 282-4, and Exhibit 282-12.*
 - (b) **RTC Site Plans:** *Exhibit 282-5, Exhibit 282-6, Exhibit 282-7, Exhibit 282-8, Exhibit 282-9, Exhibit 282-10, and Exhibit 282-12.*
 - (c) **Toll Sites on a Horizontal Curve:**
 - i. Use the following distances for each toll site element measured to the front edge of the barrier at the gutter line:
 1. TEBs: 7 feet at narrowest point
 2. RTC toll site equipment slabs: 7 feet at narrowest point
 3. Each pull box: 3 feet at the narrowest point
 - ii. The array of loop pull boxes can follow the roadway's horizontal curve
 - iii. The parallel portion of the maintenance driveway that does not taper back to the shoulder must follow the roadway's horizontal curve.
 - iv. Concrete sidewalks and toll site equipment slabs must be perpendicular or parallel to the TEB or RTC as applicable. Maintain a minimum of 18 inches between loop pull boxes and the back edge of the sidewalk.
- (2) The design of the toll site, inclusive of all exterior components except gantries, must comply with the requirements of the high velocity hurricane zone for Miami-Dade County, regardless of project location. For gantry design requirements see the ***Structures Manual, Volume 3, Chapter 19.***

- (3) When toll loop infrastructure does not extend through a wall / barrier, the toll site envelope terminates at the gutter line of the wall / barrier adjacent to the toll loop pavement area.
- (4) Concrete barrier in accordance with **Standard Plans, Index 521-001** must be installed as follows:
 - (a) Adjacent to the loop pull boxes along the toll loop pavement area.
 - (b) GFRP reinforcement must be provided for all concrete barrier within the toll site envelope.
 - (c) Concrete barrier free end and three-beam connection, as applicable, must be located beyond the toll loop pavement area.
 - (d) To protect the maintenance vehicle parking.
 - (e) See the **TEB Site Plans** and the **RTC Site Plans** for their respective site specific barrier wall layouts.
- (5) Concrete median barrier in accordance with **Standard Plans, Index 521-005** must be installed to accommodate median loop pull box installations and median gantry uprights. Use of Developmental Standard Plans requires approval by the FDOT Central Office.
- (6) The finish floor elevation of the TEB and exterior equipment slabs must be at least 18 inches higher than the following:
 - (a) The highest 100-year floodplain elevation within 500 feet of the toll site.
 - (b) 100-year design stage of all adjacent stormwater management facilities.
- (7) There must be an unobstructed perimeter of at least 5 feet around the TEB and exterior wall mounted equipment.
- (8) See the **TEB Site Plans** and the **RTC Site Plans** for additional critical clearance dimensions.
- (9) At toll sites supported on walls:
 - (a) Provide traffic barrier, wall coping, and associated junction slabs along the maintenance pull-off area up to the toll site envelope. See **Standard Plans, Index 521-512**, and **Index 521-610**.
 - (b) Provide pedestrian railing on top of the wall in accordance with **Standard Plans, Index 515-052 or Index 515-062** along the perimeter of the toll site envelope that is not subject to vehicle impacts.
 - (c) See **Standard Plans, Index 521-611** for FRP concrete barrier/junction slab wall coping.

- (10) Strut channel frames for ground-mounted equipment must be installed as follows:
 - (a) Maintenance access/clearance must be provided per NEC and manufacturer's requirements. The more stringent criteria must be used for site layout design.
 - (b) See **Exhibit 282-13** for the various frame layout details.
 - (c) See the **Toll Facility TSP Library** for the requirements for frames as follows:
 - i. **TEB Sites:** TEB Package, TSP Section for Metal Fabrications for TEB Sites.
 - ii. **RTC Sites:** RTC Package, TSP for Hangers and Supports for Electrical Systems at RTC Toll Sites
- (11) The fuel tanks must be located to allow refueling by fuel trucks with up to 100- foot-long hoses.
- (12) ADA compliant slopes and grades must be provided for all concrete sidewalks, slabs, and paved walkways within the toll site.
- (13) The generator/fuel tank must be a minimum of 8 feet from the front edge of the barrier at the gutter line.
- (14) The dry well must be located as shown in the **TEB Site Plans** and the **RTC Site Plans**.
 - (a) **TEB Sites:** Connect condensate piping from each AC unit in accordance with **Exhibit 283-30**. Route the condensate piping from each AC unit in accordance with **Exhibit 283-29**.
 - (b) **RTC Sites:** Provide a condensate receptor with air gap in accordance with **Exhibit 283-30** at each cabinet AC unit. Each cabinet AC unit, as shown in the **RTC Site Plans**, must be provided with condensate piping that connects to the dry well in accordance with the layouts shown in **Exhibit 282-11**. Include condensate piping for the future RTC cabinet.
- (15) At least 100 feet of sodding must be provided beyond the toll pavement area around each toll site. Sodding must be extended to the right-of-way lines for all areas that are disturbed by construction activities. Sodding limits must be shown on the appropriate roadway component plans.

- Exhibit 282-1: Non-Accessible Gantry TEB Standard Site Plan**
- Exhibit 282-2: Accessible Gantry TEB Standard Site Plan**
- Exhibit 282-3: Non-Accessible Gantry TEB Detached Site Plan**
- Exhibit 282-4: Accessible Gantry TEB Detached Site Plan**
- Exhibit 282-5: Single Movement Gantry RTC Standard Site Plan – On-Site Power Service**
- Exhibit 282-6: Single Movement Gantry RTC Standard Site Plan – Off Site Power Service**
- Exhibit 282-7: Dual Movement RTC Detached Site Plan**
- Exhibit 282-8: Single Movement RTC Remote Site Plan - On-Site Power Service**
- Exhibit 282-9: Single Movement RTC Remote Site Plan -- On-Site Power Service**
- Exhibit 282-10: Dual Movement RTC Remote Site Plans**
- Exhibit 282-11: RTC Condensate Piping Plans and Details**
- Exhibit 282-12: Single Movement TEB and RTC Remote Site Plan(s)**
- Exhibit 282-13: TEB and RTC Ground-Mounted Strut Channel Frame Layouts**

282.2.2 Maintenance Access

Maintenance pull-off areas must be provided for access of roadside ground mounted toll infrastructure, except when only pull boxes and / or gantry uprights are present.

282.2.2.1 Maintenance Pull-Off Area

- (1) Maintenance pull-off areas must be provided for access to the TEB and RTC.
- (2) The maintenance pull-off areas must allow for entry and exit, maintenance vehicle parking, and staging of at least two maintenance vehicles with concrete bumper guard(s).
- (3) Maintenance vehicles include box vans, lift trucks, bucket trucks, scissor lift trucks, etc. with a design size of 100 inches wide x 300 inches long.
- (4) The maintenance pull-off areas must be stabilized and physically protected from traffic by concrete barrier. See **Standard Plans, Index 521-001**.
- (5) At a minimum, the maintenance pull-off pavement must match the pavement design of the adjacent paved roadway shoulder, beyond the toll loop pavement area. See **FDM 281** and the **FDOT Flexible and Rigid Pavement Design Manuals** for pavement design requirements.
- (6) See the **TEB Site Plans** and the **RTC Site Plans** for additional geometric requirements regarding pull-off areas and site related details.
- (7) The maintenance pull-off parking must be dedicated to Tolls use only and must not be designed as a shared access for any other maintenance vehicles.
- (8) Maintenance pull-off areas must be designed to allow for vehicle outriggers of the bucket truck or scissor lift truck to be deployed adjacent to the accessible gantry access stair structure.

282.2.2.2 Barrier Access

Provide barrier access at the departure end of the toll loop pavement area as follows:

- (1) When continuous traffic barriers are present and extend beyond the limits of the toll loop pavement area, use Case I or Case II in **Exhibit 282-14**.
- (2) When the traffic barrier ends at the limits of the toll loop pavement area, use Case III in **Exhibit 282-15**.

Exhibit 282-14: Toll Site Barrier Access (1 of 2)

Exhibit 282-15: Toll Site Barrier Access (2 of 2)

282.2.3 Sidewalks

- (1) All concrete sidewalk must be 6-inch thick minimum.
- (2) The concrete sidewalk encircling a TEB must be a minimum 5-foot wide.
- (3) Sidewalk must be continuous and not contain any curbs or abrupt elevation differences in its path.
- (4) Asphalt pavement elevation must be flush with the adjacent sidewalk.
- (5) At a minimum, a 5-foot wide clear path of must be available from the maintenance pull-off area to TEBs and RTCs unless noted otherwise in the **RTC Site Plans**.
- (6) Sidewalk must be flush with the adjacent equipment slabs within the toll site envelope.
- (7) TEB finished floor elevation must be ½-inch higher than the sidewalk at the door threshold.
- (8) Concrete sidewalk joints must be constructed in accordance with **Standard Plans, Index 522-001**.
- (9) Expansion joints must be installed between concrete sidewalk and the following:
 - (a) Equipment concrete slabs
 - (b) Gantry foundations
 - (c) Concrete barriers
 - (d) Drywells
 - (e) TEB
 - (f) Pull boxes
- (10) Sidewalk joints are not permitted at the same location as loop pull boxes except along the edge. Coordinate sidewalk joints with site infrastructure locations, loop pull boxes, and other site features, including dry well, communications and ITS pull boxes, and surface mounted equipment.

282.2.4 Pipe Bollards

- (1) Removable pipe bollards must be provided around any items exposed to vehicles or maintenance equipment and as required to protect above-ground utilities and site infrastructure.
- (2) See **Exhibits 282-16 and 282-17** for additional requirements for removable pipe bollards.

- (3) Pipe bollards must be spaced no more than 4 feet apart around all generators, fuel tanks, AVI reader ground mounted frame, gantry stair foundation, and wire troughs. Pipe bollards must be placed 3 feet apart around the utility transformer pad. See the **TEB Site Plans** and the **RTC Site Plans** for bollard layouts.
- (4) Pipe bollards must be located to allow for unobstructed access and operation of the AVI reader ground mounted frames and wire troughs.
- (5) See **Exhibit 282-18** for requirements for permanent pipe bollards.

Exhibit 282-16: Removable Pipe Bollards in Asphalt

Exhibit 282-17: Removable Pipe Bollards in Gravel

Exhibit 282-18: Permanent Pipe Bollards

282.2.5 Toll Site Equipment Slabs and Toll Equipment Building Foundations

- (1) The transformer pad must be designed in compliance with the utility company requirements.
- (2) **TEB Sites:** A single slab must be designed for the generator and fuel tank as follows:
 - (a) The slab must be a reinforced monolithic concrete slab designed for the bearing conditions at each site and for the wind load criteria specified in **FDM 283.2**.
 - (b) The slab must be flush with the adjacent sidewalk/pavement and allow for positive drainage away from the TEB.
 - (c) See **Exhibit 282-19** for fuel tank hold-down details.
 - (d) Geotechnical investigation must be in accordance with the **FDOT Geotechnical Design Manual (GDM), Section 3.2.8**.
- (3) See **FDM 283.2.3** for additional TEB foundation requirements.
- (4) **RTC Sites:** See the RTC Site Plans for limits of equipment slabs and the layout of the RTC, OCC and other site components.
 - (a) Utilize the following equipment loads and areas for equipment slab design:

	Dead Load lbs	Footprint SF	Front Elevation SF	Side Elevation SF
RTC	2700	30	84	22
OCC	625	9	20	20
Generator with Fuel Tank	Site specific – Coordinate with Electrical EOR			

- (5) **RTC Sites:** Slab(s) must be designed as reinforced concrete for the bearing conditions at each site and for the wind load criteria specified in **FDM 283.2**.
 - (a) The slab must be flush with the adjacent sidewalk/pavement and allow for positive drainage of the site.
 - (b) Geotechnical investigation must be in accordance with the **FDOT Geotechnical Design Manual (GDM), Section 3.2.7**.
 - (c) The generator slab must be a minimum of 12 inches thick.
 - (d) A minimum 6-inch (unless noted otherwise) concrete slab must be provided under all other above grade electrical infrastructure.
- (6) The slab must include provisions for the concrete encased electrode conductor as shown in **Exhibit 282-38**.

Exhibit 282-19: Fuel Tank Hold-Down Details

282.2.6 Toll Site Grading

- (1) Sites must be graded to maintain positive drainage. Grading details must be provided for the entire site.
- (2) The elevation of adjacent concrete walks and driveways surrounding TEBs, generators, fuel tanks, equipment concrete pads, power distribution frames, and gantry foundations must be designed to allow positive drainage away from these elements.
- (3) Site grading within the gravel limits surrounding the bollards must be 1:6 or flatter.
- (4) Adjacent top of ditches and swales must be at least 5 feet from toll site envelope.
- (5) A minimum grade slope of 0.3% must be provided for concrete sidewalks and slabs.
- (6) Site must be graded to set the elevation of the toll loop pull boxes and intermediate pull boxes lower than the following:
 - (a) TEB finished floor
 - (b) RTC / OCC concrete slab(s)
- (7) Median pull boxes are not subject to the requirements of item (6) above.

282.2.7 Fencing for Toll Sites

Fencing must be provided if there are pedestrian facilities adjacent to a toll site or if a toll site is located outside of limited access right-of-way.

- (1) The toll site must be fenced using **Standard Plans, Index 550-002**, fence Type B. The fence must enclose the perimeter of the toll site infrastructure including generators, fuel tanks, AVI reader ground mounted frames, equipment concrete pads, and power distribution frames. Locate the pad-mounted transformer and power meter outside the fence.
- (2) The fenced area must be gated and allow for opening safely within the maintenance pull-off area. The clear opening for the gate must be at least 5 feet wide.

282.3 Toll Site Electrical

282.3.1 Toll Site Electrical Layout

- (1) The electrical infrastructure between gantries, generators, fuel tanks, pull boxes, TEBs, RTCs, OCCs, and miscellaneous equipment must be provided. Electrical equipment must be accessible for operation and maintenance activities.
- (2) Design site conduit routing in accordance with the enlarged electrical site plans below:
 - (a) TEB Sites: **Exhibits 282-20 through 282-23.**
 - (b) RTC Sites: **Exhibits 282-24 through 282-30.**
 - (c) See **FDM 282.3.3** for additional applicable exhibits for both TEB and RTC sites.
- (3) Underground duct banks must be encased in concrete. Encasement is not required if the duct bank is routed underneath concrete sidewalks, equipment concrete slabs or pavement.
- (4) See **Standard Plans, Index 630-001** for minimum conduit burial depths unless noted otherwise.
- (5) Conduits under the guardrail must be installed at least 2 feet below the guardrail post burial depth. For guardrail post burial depths, see **Standard Plans, Index 536-001.**
- (6) Pull boxes for gantry power and gantry data as shown in, **Exhibit 282-22, Exhibit 282-23, Exhibit 282-25, Exhibit 282-26, Exhibit 282-27, Exhibit 282-28, and Exhibit 282-29** and must be detailed as follows:
 - (a) All at-grade power and data pull boxes must be set on a foundation of pea rock having a minimum thickness of 12 inches as shown in **Exhibit 282-34, and Exhibit 282-35.**
 - (b) All raised median pull boxes must be set on a foundation of concrete with drainage per the loop pull box detail as shown in **Exhibit 282-36 and Exhibit 282-37.**

- Exhibit 282-20: Single Movement Non-Accessible Gantry TEB Electrical Standard Site Plan**
- Exhibit 282-21: Dual Movement Non-Accessible Gantry TEB Electrical Standard Site Plan**
- Exhibit 282-22: Dual Movement Accessible Gantry TEB Electrical Standard Site Plan**
- Exhibit 282-23: Dual Movement TEB Electrical Remote Site Plan**
- Exhibit 282-24: Single Movement RTC Electrical Standard Site Plan – Off-Site Power Service**
- Exhibit 282-25: Single Movement RTC Electrical Standard Site Plan – On-Site Power Service**
- Exhibit 282-26: Dual Movement RTC Electrical Detached Site Plan – On-Site Power Service**
- Exhibit 282-27: Single Movement RTC Electrical Remote Site Plan – On-Site Power Service**
- Exhibit 282-28: Single Movement RTC Electrical Remote Site Plan – Off-Site Power Service**
- Exhibit 282-29: Dual Movement RTC Electrical Remote Site Plans**
- Exhibit 282-30: RTC Site Generator and Working Space Detail**
- Exhibit 282-31: Single Movement TEB and RTC Electrical Remote Site Plan (1 of 2)**
- Exhibit 282-32: Single Movement TEB and RTC Electrical Remote Site Plan (2 of 2)**
- Exhibit 282-33: TEB Standard Loop Conduit Routing Plans**

282.3.2 Toll Site Power Utilities

- (1) New and/or modifications to existing underground electrical power service, electric meter, meter base, and all associated components must be provided for each toll site with on-site power service.
- (2) Toll sites must have dedicated electric power services on site except for RTC sites with off-site power services.
- (3) 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.
- (4) Coordination must take place with the utility power service providers for the primary power extension from the utility power point of presence to each toll site.
- (5) Coordination with electrical power service provider for each toll site includes:
 - (a) Cost estimate and schedule for new service connection.
 - (b) Written commitment to provide electrical service to each toll site.
- (6) All power service lines in FDOT right-of-way must be underground.
- (7) The power service conduits must be as specified by the power service providers as required for the completion of electrical service to each site.
- (8) **TEB Sites:** Power services must be 400 Amp, 120/240 Volt, single phase, 3- wire, grounded
- (9) **RTC Sites with On-Site Power Service:** Power services must be 200 Amp, 120/240 Volt, single phase, 3-wire, grounded.

282.3.3 Toll Loop Infrastructure

The design of toll loop infrastructure must account for TEC furnishing and installing the loop wiring and cabling from the pavement to the TEB or RTC. The loop infrastructure is installed by the TEC after toll site acceptance.

282.3.3.1 Toll Loop Conduits

- (1) Provide one 1-inch toll loop conduit stub-up for each equipped lane/shoulder, to each toll loop pull box from the toll loop pavement area, with a minimum of five loop conduit stub-ups per loop pull box. See **Exhibit 284-9** and **Exhibit 284-10**, for determining the number of equipped lanes and shoulders.
 - (a) Rigid Pavement
 - i. At least one loop conduit must stub up in each slab segment bounded by pavement joints of any type. Coordination with the Turnpike must take place for vendor specific toll loop conduit stub-up locations.
 - ii. The longitudinal and lateral positioning of all conduit layouts in the pull boxes must comply with **Exhibit 282-34** and **Exhibit 282-36** and must be stubbed up in the lanes as stated above.
 - (b) Flexible Pavement
 - i. The 1-inch toll loop conduits from the loop pull boxes must stub up in the 12-inch wide toll header curb adjacent to the concrete barrier. See **Exhibit 282-35** and **Exhibit 282-37**.
 - ii. Coordinate with Turnpike Tolls Design for conduit stub-up locations along the concrete barrier to avoid future TEC loop conflicts.
- (2) See **Exhibits 282-34 through 282-37** for the toll loop conduit layout details.
- (3) At toll sites with no ELs, loop conduit must be routed as follows:
 - (a) Two or fewer lanes – Route to toll loop pull boxes adjacent to either the inside or outside shoulder.
 - (b) Three or more lanes – Provide toll loop pull boxes adjacent to the outside and inside shoulders and route loop conduits to the nearest side.
- (4) At toll sites where, TLs and ELs are tolled at the same location, loop conduit must be routed as follows:
 - (a) TLs – Route to toll loop pull boxes adjacent to the TL shoulder.
 - (b) ELs – Route to toll loop pull boxes adjacent to the EL shoulder.
- (5) When only express lanes are tolled, toll loop conduit must be routed as follows:
 - (a) ELs – Route to toll loop pull boxes adjacent to the EL shoulder.
 - (b) GULs and TLs adjacent to the buffer – Route to toll loop pull boxes adjacent to the EL shoulder.

282.3.3.2 Toll Loop Pull Boxes

- (1) Seven (7) toll loop pull boxes must be provided per tolling direction.
- (2) Additional toll loop pull boxes are required for remote, bi-directional or reversible tolling sites depending on the home run conduit routing design. See **Exhibit 282-22**, **Exhibit 282-23**, **Exhibit 282-26**, **Exhibit 282-27**, **Exhibit 282-28**, and **Exhibit 282-29** for additional information.
- (3) Coordination with Turnpike Tolls Design must take place for a pull box layout for any tolling movement supporting more than six equipped lanes and shoulders.
- (4) The toll loop pull boxes must be located behind concrete barriers. The use of guardrail in place of concrete barrier is not permitted when adjacent to toll loop pull boxes. See **FDM 282.2.1** for additional requirements regarding the concrete barrier.
- (5) The toll loop pull box must be positioned as follows:
 - (a) See the **TEB Site Plans** and the **RTC Site Plans** defined in **FDM 282.2.1** for toll loop pull box layouts.
 - (b) Toll loop pull boxes must not be located in roadway pavement lanes or shoulders.
 - (c) If cable distances cannot be met, coordination with Turnpike Tolls Design must take place for alternative toll loop pull box locations.
 - (d) At ramp toll sites with a single tolling movement, the toll loop pull boxes must be located on the TEB or RTC side of the roadway, behind the shoulder and concrete barrier.
 - (e) Toll loop pull boxes placed within median barrier must be elevated to align with the tops of the walls as shown in the **Standard Plans, Index 521- 005**.
- (6) The toll loop conduits entering the median toll loop pull boxes must be coordinated with the gantry foundation(s), concrete barrier, and the reinforcement placement in these elements. See **Exhibit 282-36** and **Exhibit 282-37** for additional requirements.
- (7) The toll loop pull boxes for each tolling movement must be encased in concrete that encompasses all toll loop pull boxes as a group for that tolling movement. Individual toll loop pull box concrete encasements are not permitted.
- (8) A minimum of 6-inch separation between the toll loop conduits inside the pull box must be provided.

- (9) Provide in-grade intermediate pull boxes or hand holes lower than the following floor / slab elevations:
 - (a) At TEB sites when the top of any in-grade pull box or hand hole that directly connects to the TEB is located at a higher elevation than the TEB finished floor elevation.
 - (b) At RTC sites when the top of any in-grade pull box or hand hole that directly connects to the OCC and / or RTC is located at a higher elevation than the toll site equipment slab elevation at the reference points to the OCCs and / or RTCs.
 - (c) See **TEB Site Plans** and **RTC Site Plans** defined in **FDM 282.2.1** for intermediate pull box placement where required above.
- (10) Toll loop and intermediate pull boxes must be 30-inches wide x 48-inches long x 24-inches deep. They must have an open bottom and include a one-piece cover.
 - (a) All at-grade pull boxes must be set on a foundation of pea rock having a minimum depth of 12 inches. See **Exhibit 282-34** and **Exhibit 282-35**.
 - (b) All raised median pull boxes must be set on a foundation of concrete as shown in **Exhibit 282-36** and **Exhibit 282-37**.

282.3.3.3 Toll Loop Home Runs

- (1) See **Exhibits 282-20 through 282-23** for the routing of 3-inch conduits between pull boxes and for home runs to TEBs.
- (2) See **Exhibits 282-24 through 282-29** for the routing of 3-inch conduits between pull boxes and for all home runs to RTCs.
- (3) See **Exhibits 282-34 through 282-37** for the toll loop home run details at the pull box locations.
- (4) When one set of toll loop pull boxes serves two directions of travel, toll loop home runs for each direction of travel must run in separate conduits.
- (5) Home runs must be routed to the TEB or RTC via underground duct banks, directional bores, pull boxes, splice vaults, wireways, conduits, and building or cabinet penetrations.
- (6) See **FDM 282.3.1** for conduit burial depth requirements.

Exhibit 282-34: Toll Loop Pull Box Details for Rigid Pavement

Exhibit 282-35: Toll Loop Pull Box Details for Flexible Pavement

**Exhibit 282-36: Elevated Toll Loop Pull Box Details for Rigid
Pavement**

**Exhibit 282-37: Elevated Toll Loop Pull Box Details for Flexible
Pavement**

282.3.4 Toll Site Power Distribution

- (1) Toll site power panels distribute power to the toll site and must be dedicated to toll site loads only. They must not be shared with non-tolling electrical loads.
- (2) **TEB Sites:** See **FDM 283.3.4** for power panel requirements.
- (3) **RTC Sites with on-site power:**
 - (a) Provide one new emergency distribution panel (EDP) rated 200 amps, 120/240 volts, along with associated components. See **Exhibit 282-38** for the RTC power riser diagram.
 - (b) See **FDM 282.3.4.1** for all circuits to be fed by panel EDP.
 - (c) The electrical loads used in load calculations must be rated full load of the equipment.
- (4) **RTC sites with off-site power:**
 - (a) Review the cost efficiency of using off-site power for an RTC site by comparing costs of installing copper feeder conductors versus cost of an on-site generator and utility connection (typical viable distances are at approximately 750 feet).
 - (b) Power must be fed from a RTC site with an on-site power service. See **Exhibit 282-38** for the RTC power riser diagram.
 - (c) Provide one new emergency panel (EP1) rated 100 amps, 120/240 volts, along with associated components.
 - (d) See **FDM 282.3.4.2** for all circuits to be fed by panel EP1.
- (5) Panelboards must comply with the requirements in **Toll Facility TSP Library** as follows:
 - (a) **TEB Sites:** TEB Package, TSP Section for Panelboards for TEB Sites.
 - (b) **RTC Sites:** RTC Package, TSP for Panelboards at RTC Toll Sites.

282.3.4.1 Circuits from Roadside Tolling Cabinet On-Site Power Panel EDP

- (1) Provide circuit breakers in panel EDP:
 - (a) Two (2) 15A, 240V branch circuits, one for each air-conditioner in the OCC.
 - (b) One (1) 20A, 120V feeder for the 2 KVA UPS in the OCC for the OCC components.

- (c) One (1) 30A, 240V feeder for the 5 KVA UPS in the OCC for each RTC.
- (d) One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures in the OCC.
- (e) For each RTC:
 - i. Two (2) 20A, 240V branch circuits, one for each air-conditioner.
 - ii. One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures.
- (f) For the Future RTC:
 - i. Two (2) 20A, 240V branch circuits, one for each air-conditioner.
 - ii. One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures.
- (2) Provide circuit breakers in panel EDP, and associated conductors for the following:
 - (a) Generator:
 - i. One (1) 20A, 120V branch circuits, for the battery charger.
 - ii. One (1) 20A, 120V branch circuit for the jacket water heater.
 - (b) Lighting: One (1) 20A, 120V branch circuit on the power distribution frame.

282.3.4.2 Circuits from Roadside Tolling Cabinet Off-Site Power Panel EP1

- (1) Provide circuit breakers in panel EP1:
 - (a) Two (2) 15A, 240V branch circuits, one for each air-conditioner in the OCC.
 - (b) One (1) 20A, 240V feeder for the 2 KVA UPS in the OCC for the OCC components.
 - (c) One (1) 30A, 240V feeder for the 5 KVA UPS in the OCC for each RTC.
 - (d) One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures in the OCC.
 - (e) For the RTC:
 - i. Two (2) 20A, 240V branch circuits, one for each air-conditioner.
 - ii. One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures.
 - (f) For the Future RTC:
 - i. Two (2) 20A, 240V branch circuits, one for each air-conditioner.

- ii. One (1) 20A, 120V branch circuit for the convenience receptacle and light fixtures.
- (2) Provide circuit breakers in panel EP1, and associated conductors for the lighting with one (1) 20A, 120V branch circuit on the power distribution frame.

282.3.4.3 Circuits from OCC

- (1) For components in the OCC: Provide power output ports from the 2 KVA UPS for the following OCC components:
 - (a) SCADA: cord and plug connection, 120V 15A
 - (b) Network Video Recorder (NVR): cord and plug connection, 120V 15A
 - (c) WAN Switch: two (2) cord and plug connections, 120V 20A
 - (d) SCADA PM Encloser on Power Distribution Frame: 120V 15A
- (2) For each RTC: Provide one 30A 240V hard-wired power circuit from each 5 KVA UPS.

Exhibit 282-38: RTC Power Riser Diagram

282.3.5 Electrical Equipment Frame Layout

There are multiple types of strut-channel frames supporting the electrical equipment needed for toll sites.

See **FDM 282.2.1** for site layout requirements of the ground-mounted frames.

282.3.5.1 Equipment Mounted to AVI Reader Ground-Mounted Frame

- (1) See **FDM 284.6.5.6** for determining when AVI reader ground-mounted frames must be used.
- (2) See **Exhibit 282-40** for the AVI reader fiberglass NEMA 4 enclosure layouts.
- (3) Provide a NEMA 3R, 12-inch H x 12-inch W x 24-inch L wire trough.
- (4) See **Exhibit 284-11** for equipment loads.

282.3.5.2 Roadside Tolling Cabinet Equipment Mounted to Power Distribution Frames

- (1) Provide toll site power panels and associated SPDs.
- (2) Provide lighting on each face.
- (3) Provide CCTV on each face.
- (4) See **Exhibit 282-39** for the details of both On-Site Power Service and Off-Site Power Service, power distribution frames.

Exhibit 282-39: RTC Power Distribution Frame Layouts

Exhibit 282-40: AVI Reader Ground-Mounted Frame Layouts

282.3.6 Lighting at Toll Sites

- (1) See **FDM 283.3.2** for TEB lighting requirements.
- (2) See **Toll Facility TSP Library** , TEB Package, TSP Section for Lighting Fixtures, Lamps, and Ballasts at TEB Sites for additional requirements.
- (3) Lighting requirements for RTC Sites:
 - (a) An exterior lighting system must be provided consisting of at least two strut channel-mounted light fixtures with integral photocells.
 - (b) Light fixtures must be installed at 87-inches above finished grade to the center of the fixture.
 - (c) Use Type B fixture from **Exhibit 283-15** light fixture schedule.
 - (d) See **Exhibit 282-39** for fixture location mounting details.
 - (e) See **FDM 282.3.4.1** and **282.3.4.2** for lighting circuit requirements.
 - (f) See GTR Part 2 Appendix 3, TSP for Lighting Fixtures and Lamps at RTC Toll Sites for additional requirements.

282.3.7 Generators, Fuel Tanks, and Automatic Transfer Switches

- (1) Diesel emergency generator packages, automatic transfer switches, and fuel tanks must be provided at all toll sites except RTC sites with off-site power service.
- (2) The toll site emergency power system must not serve non-tolling related electrical loads such as ITS systems, roadway lighting, etc.
- (3) See **FDM 282.2.1** for additional generator and fuel tank requirements.
- (4) **TEB Sites:**
 - (a) Provide separate fuel tank and generator as shown on the **TEB Site Plans** defined in **FDM 282.2.1**.
 - (b) See **Toll Facility TSP Library** , TEB Package, TSP Section for Automatic Transfer Switches at TEB Sites and Emergency Generator at TEB Sites for additional requirements.
- (5) **RTC Sites:**
 - (a) Provide a generator with integral base tank as shown on the **RTC Site Plans** .
 - (b) See **Toll Facility TSP Library** , RTC Package, TSP for Automatic Transfer Switches at RTC Tolls Sites and Emergency Generator at RTC Tolls Sites for additional requirements.

282.3.8 Surge Protection Devices (SPDs)

- (1) **TEB Sites:** See **FDM 283.3.10** for SPD requirements
- (2) **RTC Sites:**
 - (a) SPDs must be provided for all power panels and transfer switch.
 - (b) See **Toll Facility TSP Library** , RTC Package, TSP for Surge Protective Devices 1KV or less at RTC Toll Sites for additional requirements.

282.3.9 Toll Site Security

282.3.9.1 Closed Circuit Television (CCTV) System

- (1) Conduit, junction boxes, fittings, connections, power cabling, pull ropes and other infrastructure required for the Turnpike-installed CCTV equipment must be provided.
- (2) See **Exhibit 282-41** and **Exhibit 282-42** for quantity and layout of boxes to support the CCTV cameras.
- (3) The Turnpike will furnish and install the security system, cabling and all cameras on the site.
- (4) **TEB Sites:** Raceways to the data side of the ceiling mounted cable tray for each building mounted CCTV surveillance camera must be provided in accordance with **Exhibit 283-13** and **Exhibit 283-14**.
- (5) **RTC Sites:** See **Exhibit 282-39** for CCTV mounting details.

282.3.9.2 Site Access Control

When toll site fencing and gates are required per **FDM 282.2.7**:

- (1) All necessary conduit, junction boxes, fittings, connections, and miscellaneous hardware must be provided for power and data cabling required for the access control system.
- (2) Coordinate with Turnpike Toll Systems Department and Turnpike Tolls Design for determination of owner furnished devices.

Exhibit 282-41: CCTV Camera Site Locations for TEB Sites

Exhibit 282-42: CCTV Camera Site Locations for RTC Sites

282.3.10 Toll Site Supervisory Control and Data Acquisition (SCADA) Systems

- (1) One SCADA control panel must be provided for each toll site.
- (2) **TEB Sites:** See **FDM 283.3.6** for TEB sites SCADA system requirements.
- (3) **RTC Sites:** SCADA system for RTC sites must be in accordance with the following:
 - (a) The SCADA system must connect to the toll site assets as shown in **Exhibit 282-43**, **Exhibit 282-44**, and
 - (b) For electrical power to the SCADA panel refer to **FDM 282.3.4.3**.

Exhibit 282-43: RTC SCADA Riser Diagram (1 of 3)

Exhibit 282-44: RTC SCADA Riser Diagram (2 of 3)

Exhibit 282-45: RTC SCADA Riser Diagram (3 of 3)

282.3.11 Electrical Infrastructure for Roadside Tolling Cabinet Sites

- (1) Vertical raceways that originate from the gantry must terminate as described in **FDM 284.6.5.1**.
- (2) See **Exhibit 282-30** for working space details and conduit layouts under the site equipment.
- (3) Loop pull box raceways must be routed to the stub up, under the appropriate working spaces under the RTCs and the future RTC pull box.
- (4) All conduits must be stubbed up to 1-inch above the finished equipment slab elevation with a cable ground bushing installed at both ends of all metallic conduits.
- (5) Conduits from each wire trough must terminate as follows:
 - (a) CCTV: Two 2-inch rigid conduits for each direction of travel must be routed from data wire trough to the working space under the OCC.
 - (b) Data: Three 3-inch data conduits (not associated with CCTV) must be routed from data wire trough to the appropriate working spaces of each RTC and the future RTC pull box.
 - (c) AVI Readers on ground-mounted frame:
 - i. Two 4-inch rigid conduits must be routed from the bottom of the upright and terminate at the AVI reader frame as shown in **Exhibit 282-40**.
 - ii. Two 3-inch rigid conduits must be routed from the bottom of the AVI reader frame wire trough and stub up in the appropriate working spaces of each RTC and the future RTC pull box.
 - iii. See **FDM 284.6.5.6** for additional requirements.
 - (d) AVI Readers mounted on the gantry: Two 3-inch rigid conduits must be routed from the bottom of the AVI reader wire trough and stub up in the appropriate working spaces of each RTC and the future RTC pull box.
 - (e) Power: Two 2-inch rigid conduits must be routed to the appropriate working spaces of each RTC and the future RTC pull box.
- (6) Generator underground cable routing must be as follows:
 - (a) One 2-inch conduit for the generator power feeders to the ATS.
 - (b) One 1-inch conduit to the ATS for generator control wiring.
 - (c) One 1-inch conduit to SCADA wireway.
 - (d) One 1-inch conduit to EDP for engine jacket heater circuit.

- (e) One 1-inch conduit to the BCU for the generator battery circuit.
- (7) See **FDM 284.6.5.8** and **284.6.5.9** for cantilever gantry conduit routing requirements.

282.3.12 Department Provided Infrastructure for Roadside Tolling Cabinet Sites

282.3.12.1 Equipment

The following components are provided by the Department:

- (1) Within the OCC:
 - (a) CCTV NVR
 - (b) WAN ethernet Switch
 - (c) Access control
- (2) RTC(s) provided via the Department's TEC
 - (a) TEC equipment
 - (b) Dual air conditioners and related controls
 - (c) In-cabinet lighting
 - (d) Cable management
 - (e) PDUs
 - (f) Access control
- (3) CCTVs as shown in **Exhibit 282-42**

282.3.12.2 Conductor and Cable Terminations

- (1) Provide coiled conductors with sufficient slack to allow the Department to terminate power conductors between:
 - (a) EDP and RTC(s)
 - (b) EP1 and RTC
 - (c) OCC and RTC(s)
- (2) Provide coiled cables with sufficient slack to allow the Department to terminate data cables between the OCC and the RTC(s) (SCADA, FOC, and Access Control)

282.4 Toll Site Lightning Protection

282.4.1 Lightning Protection for Site Infrastructure

Lightning protection must bond to each applicable toll site element listed below:

- (1) TEB counterpoise loop (provide additional ground rods)
- (2) OCC
- (3) RTC(s) (provide additional ground rods adjacent to the RTC(s) and future RTC)
- (4) Generator and fuel tank (provide additional ground rod)
- (5) Gantry uprights counterpoises (provide additional ground rods)
- (6) Toll site ground-mounted strut channel frames
- (7) Any additional metallic site elements

282.4.2 Lightning Protection Separation Distances

- (1) The underground lightning protection system conductors must be at least 36 inches vertical or horizontal, from conduits that serve the tolling equipment.
- (2) Lightning conductors must not be routed under the toll pavement area. The underground lightning protection system conductors must be at least 36 inches horizontally from the toll loop pavement area limits except as allowed in the item below.
- (3) The lightning conductors for median barrier gantry uprights must be routed to maximize the distance between the toll loop pavement area(s) and the conductor.

282.5 Cable Distance Limitations

282.5.1 Definitions and Measurement

Calculated cable distance is the distance between the originating and terminating devices of a cable run including all bends, turns, and elevation differences.

The following must be added to the calculated cable distance as measured in plan and elevation:

- (1) 15 percent for cable runs that are in directional bores or drills.
- (2) 10 percent for cable runs that are not in directional bores or drills.

282.5.2 Boosters and Amplifiers

The use of cable signal boosters or amplifiers (boosters) is not permitted.

282.5.3 Cable Distance Limitations

- (1) The cable distance between an AVI antenna and its corresponding AVI reader must not exceed 100 feet.
- (2) The ethernet cable distance between the AVI reader and the toll equipment working spaces inside the TEB or RTC must not exceed 250 feet.
- (3) The cable distance between any remaining toll equipment mounted to the J-arms and the toll equipment working spaces inside the TEB or RTC must not exceed 250 feet.
- (4) The cable distance between any tolling loop and the toll equipment working spaces inside the TEB or RTC must not exceed 250 feet.
- (5) See **Exhibit 282-46** for an example how to calculate cable distance for each toll equipment for toll sites with TEBs. The cable distances for toll sites with RTCs are calculated in a similar manner to toll sites with TEBs.

Exhibit 282-46: Calculated Cable Distances