APPENDIX C-7

Toll Barrier Mechanical Systems

I. GENERAL

The mechanical systems discussed herein are based on the preferred toll plaza configuration (i.e., Exterior Plaza w/ Toll Booth Access Options via Tunnel or Overhead Corridors). The Exterior Plaza configuration includes an operations building, toll plaza and a plaza support building. The mechanical systems under each toll booth access option are basically the same. The main difference is in the configuration, location and routing of the air distribution ductwork and piping serving the tollbooths. For each option, the following mechanical systems will be provided:

- Heating Ventilating and Air Conditioning (HVAC) System
- Plumbing and Drainage System
- Fire Protection System

II. HVAC SYSTEM

The operating characteristics of the Toll Plaza will be significantly different than those of the Operations and Support buildings. Therefore, the Toll Plaza will be provided with a separate HVAC system. The Plaza Support Building, which mainly includes the comfort facilities for the toll collectors, is considered an extension of the Operations Building. Therefore, for the conceptual analysis, a common HVAC system will be assumed to serve both buildings. Furthermore, because of the uncertainty with the availability of natural gas, electrical heating is assumed for the conceptual analysis. Each HVAC system will be of self-contained packaged type with DX coils (air cooled). During the detailed design phase, cost effective alternatives and other system modifications such as the heating source alternatives, a separate HVAC system for the Support Building, a common chiller for the HVAC systems, etc. will be evaluated and most suitable alternatives will be selected.

A. Special Considerations

The Operations Building and tollbooths will be exposed to high concentrations of vehicle-emitted air pollutants. Therefore, the outside air intake should be located such that it is free of the vehicle exhaust as much as possible. An air intake located in ROW north of the Operations Building (away from the parking area), or in ROW south of the eastbound lanes will be less likely to be exposed to vehicular exhaust. Therefore, it is proposed that the air intake gratings/louvers be located in either of these two locations.

The air intake should be raised above the surface as much as possible to minimize snow and dust ingress. A height of 10’ to 12’ is considered ideal. Air intake duct, approximately 16 sq ft in area, will run to the M&E equipment room in the Operations Building then feed to the HVAC equipment and miscellaneous supply air fans.

The HVAC system for the booths should satisfy not only the temperature criteria but also inhibit infiltration of outside air into booth’s environment. A re-circulating ventilation system with positive pressure will reduce outside air infiltration to some degree. However, it cannot prevent fume infiltration as long as part of the ventilation air is re-circulated.

Therefore, it is proposed that the ventilation system for the tollbooths be designed to use 100% outside air (zero re-circulation).

The Operations and Support Buildings will be located adjacent to the roadways. As a result, these buildings will also be exposed to high concentrations of vehicle-emitted pollutants. Therefore, the ventilation system for the building will be designed to provide positive pressure and will be slightly over pressurized to minimize infiltration of the outside air. Positive ventilation will be maintained with a higher percentage of outside air than the percentage normally used.

B. HVAC System for the Operations Building

The HVAC system for the Operations Building consists of four distinct subsystems:

- Comfort HVAC system
- Ancillary space air conditioning system
- Ancillary space heating and ventilation system
- Access tunnel/bridge corridor heating system

1. Comfort HVAC system

A central HVAC unit will provide heating, ventilating, and air conditioning for the occupied spaces. The unit will be a self-contained packaged HVAC unit with air-cooled condenser (no water chillers) and electrical heating coils. Outside air will be drawn in through the common air intake gratings/louvers. The treated air will be distributed to various occupied spaces (offices) via overhead ducts. Perimeter heating at the exterior walls will be provided using electric wall convectors. The air from toilets and lockers will be exhausted directly to atmosphere. The ventilation system will include a free cooling mode (all outside air mode) to supply 100% outside air when the ambient air is at moderate temperatures.

2. Ancillary Space Air Conditioning System

Ancillary spaces that house computers, UPS, relays, and other solid state equipment will be provided with self contained air conditioning units to maintain the space temperatures within the acceptable range to support operation and prolong the equipment life. These rooms will be provided with humidity control to maintain the relative humidity level recommended by the solid-state equipment manufacturers.

3. Ancillary Space Heating and Ventilation System

All ancillary spaces such as switchgear room, fan rooms, etc., will be heated and ventilated. No mechanical cooling will be provided. Outside air will be drawn in through the common air intake gratings/louvers. Supplemental heating will be provided using electrical unit heaters, convectors or infrared heaters as appropriate. The ventilation system will include supply and/or exhaust fans. To optimize the space allocation, the ancillary spaces will be served by a common ventilation system where possible. However, rooms with differing operating characteristics will be provided with separate supply and/or exhaust fans.

4. Access Tunnel / Overhead Corridor Heating and Ventilating System

Access tunnel (or overhead corridor) will be heated to maintain space temperature above 50^0F to avoid maintenance related problems. For the tunnel alternative, electrical unit heaters will be provided in strategic locations. For the overhead corridor alternative electrical wall convectors or cabinet heaters will be provided. A separate ventilation system will be provided to maintain positive pressure in tunnel (or overhead corridor). The ventilation system will include reversible fans that will operate in exhaust mode to remove smoke from the access tunnel/overhead corridor if required.

C. Toll Barrier HVAC System

Two types of HVAC systems are commonly used for tollbooths: Individual HVAC units and a central HVAC system with air distribution duct work to each tollbooth.

Individual HVAC units offer advantages in terms of individual control by each tollbooth attendant, and the flexibility of replacing one unit without affecting the operation of other booths. However, these HVAC units are energy inefficient. Variable air volume control is not available on these units because they have small cooling capacities. As a result, the individual HVAC units provide the cooling and heating at the same rate irrespective to the booth window openings. A central HVAC system provides energy efficient installation. With variable air volume (VAV) or variable air and variable temperature (VVT) type controls on the air supply, the ventilation system can be made responsive to the opening and closing of the booth windows. A temperature control device in each booth allows the booth attendants to set space temperature at the level considered comfortable. Therefore, a central HVAC system serving all tollbooths is considered a most suitable alternative.

The central HVAC system for the toll plaza will include an HVAC unit and air duct into individual booths. The central HVAC unit will be located in the Mechanical Equipment Room on the second floor of the Operations Building. The unit will be self-contained packaged HVAC unit with air-cooled condenser and electrical heating coils. Outside air will be drawn in through the common air intake. The treated air will be distributed to individual booths with air ducts to be located on the plaza canopy. A VAV or VVT type controls will be provided to regulate air supply to each booth. For floor level heating a small cabinet heater with fan will be provided in each booth to avoid cold feet syndrome. This will also act as a back up to the main heating system.

III. PLUMBING AND DRAINAGE SYSTEM

The plumbing and drainage system for the proposed toll barrier facility will include the following:

- Potable Water Supply System
- Sanitary Drainage System
- Storm Drainage System

The Operations Building, Toll plaza and the Plaza Support Building will be served with water main sized for the total plumbing demand. The sizing of the water lines will be based on maintaining uniform pressure at plumbing fixtures and minimizing shocks and water hammering while

maintaining a minimum pressure of 25 psig at each flush valve. Potable hot water system for the toilets and kitchen will be provided using a central hot water heater. Where judged to be appropriate, instantaneous electric water heaters will be provided.

The sanitary system will include drainage piping from all plumbing fixtures and floor drains to the nearby sanitary disposal system. A vent system for all sanitary lines will be provided. The sanitary waste and vent systems will be sized for the fixture demand as required by the applicable plumbing code. Oil-water separators will be provided in sanitary drainage system in accordance with plumbing codes.

Storm drainage system will collect storm water from the building roofs and plaza canopy and convey it, under gravity, to the roadway drainage system.

IV. FIRE PROTECTION SYSTEM

The fire protection system to be provided will include the following:

- Standpipes,
- Automatic Sprinklers,
- Clean Agent Fire Extinguishing System
- Portable Fire Extinguishers.

The Operations and Support building will be protected with automatic sprinklers and standpipe systems. The access tunnel (or the bridge corridor) will not be equipped with standpipe or sprinkler system but will be provided with fire detection and alarm systems. Portable fire extinguishers of appropriate rating will be provided in all ancillary rooms and the tollbooths. Electrical rooms that house UPS and other solid state equipment which are vital for the overall life safety preparedness will be protected with clean agent fire extinguishing systems.

V. SPACE ALLOCATION

Air handlers, supply and exhaust fans, hot water boiler, and other indoor type equipment will be located in the M&E equipment room on the second floor of the Operations Building. It is estimated that indoor units will collectively require a floor space of 40 ft x 40 ft. Heat rejection equipment (condensers) will be located on the roof adjacent to the M&E equipment room. An air intake grating/louver of approximately 30 sq. ft. will be located as far away from traffic/vehicular emissions as possible. An outside air intake duct of 16 sq. ft. from the grating/louver to the M&E equipment room will be required. A supply air duct for the toll booths will start out with an area of approximately 6 sq. ft. from the M&E equipment room and reduce in size after feeding off the booths. Another duct of approximately 2 sq. ft. will also run on the plaza canopy to distribute ventilation air to the Support Building. Both supply air ducts (for the booths and the Support Building) will be installed on the top of the plaza canopy. For the tunnel alternative in areas where there is no plaza canopy (E-ZPass lanes) these ducts would have to be routed through the tunnel and then back to the top of the canopy.