Attachment 20
Gate Control System Interface Functional Requirements

1. Gate Control System (GCS) Interface Functional Requirements

The Gate Control System (GCS) is considered essential to reversible lane operations and is therefore the most critical ITS subsystem for US-74 from both a safety and a maintenance standpoint. The integrator will be responsible for developing the interface between the GCS and the toll collection system host. The GCS will be installed by others to prevent motorists from unintentionally entering the reversible Express Lane from the wrong direction. Gates will be used to close off Express Lane access ramps that would flow opposite the prevailing direction of traffic. This would occur when the direction of flow in the US 74 Express Lanes is reversed to accommodate the traffic flow heading west during the AM Peak Period and heading east during the PM Peak Period. The GCS will control these gates and the DMS that alert drivers whether the reversible lane is open, closed or closing, and thus must be fully fault-tolerant, with no downtime. While the GCS will have a built-in Uninterruptable Power Supply (UPS) backup to provide for continuous operation during brief power outages, any malfunctions or improper operations will require immediate response from maintenance personnel.

GCS Interface Functional Requirements[1]

High level functional requirements of this interface are described below. However, it is important to note that as with the other ITS components for US-74, the design of the GCS is currently underway and finalized specifications, including operating hours, will not be available before August 2016 at the earliest. For further reference, the concept design and operation of the GCS is described in greater detail in Attachment 3 (US-74 Express Lanes, Concept of Design & Operations, dated January 12, 2016). At the highest level, the integrator must provide an interface to the installed gate manufacture's provided communications and control software for the GCS to support the following functions:

- Monitor and control the position of gates at all times to ensure operational safety
- Fault-tolerate operations
- Transmit and receive alerts and status updates to/from the Maintenance On-Line Management subsystem
- Communicate with DMS to alert drivers as to the status of the reversible lane: open, closed, closing
- Communicate with wrong-way driver signage detection and signage components

1.1. Reversible Lane Operations

The GCS interface will communicate with the automated barrier gates, dynamic signs, and static signs that will be used to control, monitor and manage the reversible lane operations.

The US 74 Express Lanes operator at the MRTMC shall be able to remotely control automated reversible lane equipment (e.g. gates) and driver information systems (e.g. signs, lane control signals, etc.) that control access and egress to reversible lanes as well as traffic in the reversible lane.

Since the US 74 Express Lanes do not have dedicated lanes for each direction of traffic, it is necessary for the Express Lanes to operate only for traffic in the prevailing direction at designated times during the day. This mode will require the west end section (west of Albemarle Road) to operate as a reversible lane flowing westbound during the AM peak period, and eastbound during the PM peak period.

During the mid-day off-peak, the reversible lane will be closed for approximately two hours to clear the facility of all traffic before reopening in the reverse direction and to support maintenance activities. During overnight off-peak hours, the reversible lane will be closed for a second two hour period for routine clearing of all traffic and any further maintenance activities required in preparation for reopening in the morning.

The eastern (2-way) section will not operate independently of the western reversible section; during the reversal period, the entire Express Lane corridor will be closed.

The reversible lane and GCS will be an interlocked, modular system that is sequenced for opening and closing the US 74 Express Lanes.

[1] Summarized from US-74 Express Lanes, Concept of Design & Operations, dated January 12, 2016.

Safeties must be built in so that operators cannot open a path for traffic until the opposite path is closed.

Manual checkpoints will be performed by NCDOT for verification that all traffic in the corridor has been cleared.

In addition to local control from the site of the gate controller, the interface will allow, with appropriate security, remote operation from the MRTMC and the STOC.

Additional interfaces from devices such as cell phones, RF units or via Web-based interfaces may also be permitted with the appropriate security levels.

Reversal confirmation will likely occur with a vehicle operator and the assistance of a TMC operator for CCTV visual confirmation.

1.2. Switchover / Reversing Direction of Traffic Flow

The process of switchover involves using a combination of the GCS software managed by TMC operators and CCTV monitoring prior to switchover. The switchover is performed by the TMC and would occur following sequential gate closures along the directional facility (beginning at the east end for westbound traffic, beginning at the west end for eastbound traffic). These reversible lane management operations shall include physical on-site "sweep" operations by roadway field staff during directional changes to verify that no vehicles are entering, nor are there any vehicles remaining in the reversible lanes. Once the road is verified as "clear" to TMC staff, the direction of traffic is reversed. The switchover should typically take less than one hour.

1.3. Maintenance Operations

The GCS interface must support the transmission and receipt of alerts and status updates to/from the maintenance online management system. This should include messages pertaining to preventative and corrective maintenance activities. Regular maintenance will help in preventing failures which includes lubrication, cleaning and testing.

Routine or preventative maintenance of the GCS would be accomplished during off-peak/closed times when there is no traffic in the US 74 Express Lanes and access to the lanes is secured by the GCS. Typically there would be two time slots of at least two hours in duration when the maintenance could take place.

Maintenance of the reversible gate system would be handled in a manner similar to the toll site maintenance.

In the event of a catastrophic failure, lanes could be closed using the gate system on off-peak times or during the night to perform the repairs.