

FEDERAL HIGHWAY ADMINISTRATION APPLICATION

REQUEST FOR PERMISSION TO EXPERIMENT WITH

**Adaptive Flashing Red Arrow Signal Indication to provide
protected only-protected/permissive left turn control**

Submitted to:

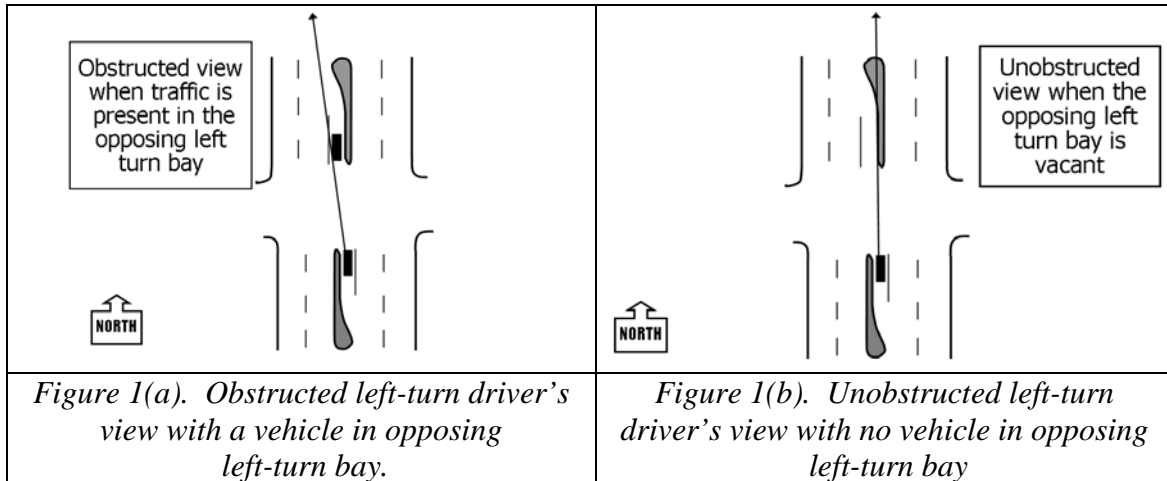
Texas Department of Transportation
and
Federal Highway Administration Office of Traffic Operations

Submitted by:
City of Austin, Texas

Date:
July 2011

BACKGROUND

At many signalized intersection locations, a left turning driver's view of oncoming traffic may be obstructed if the opposing left turn lane is occupied. Often, a protected only left turn phase is implemented to reduce the potential for crashes if permissive left turns had been allowed. However, when the opposing left turn lane is unoccupied, the view of oncoming traffic may be unobstructed. This is illustrated in figures 1(a) and 1(b).



When the view of oncoming traffic is unobstructed and a protected only left turn is in place, left turning drivers are often frustrated at not being able to make a permissive turn and may disregard the left turn signal under such conditions. An adaptive left turn control that can display either a protected or a permissive left turn indication based on the absence or presence of a vehicle in the opposing left turn bay will permit increased efficiency and reduce driver frustration at many signalized locations. This request describes an Adaptive Flashing Red Arrow (AFRA) signal indication that would provide permissive left turn opportunities if the opposing left turn bay is unoccupied. An assumption associated with the use of the proposed AFRA signal sequence is that detection equipment is in place to determine whether or not the opposing left turn lane is occupied.

The City of Austin is leading this experimental effort with assistance from researchers at The University of Texas at Austin's Center for Transportation Research (CTR). CTR has previous experience in studying a wide variety of traffic control concepts and notably has recently completed testing of four proposed bicycle facility control devices under terms of requests for experimentation.

NEED FOR EXPERIMENTATION

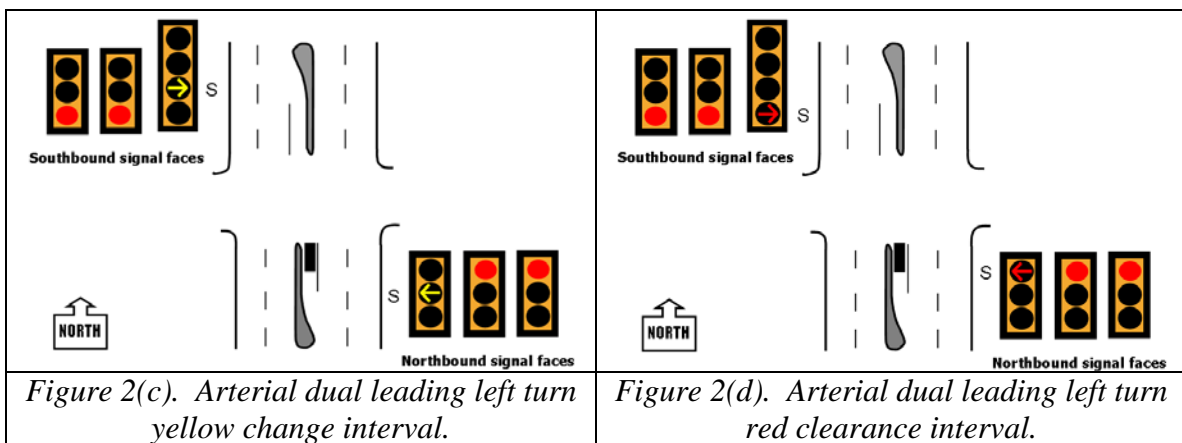
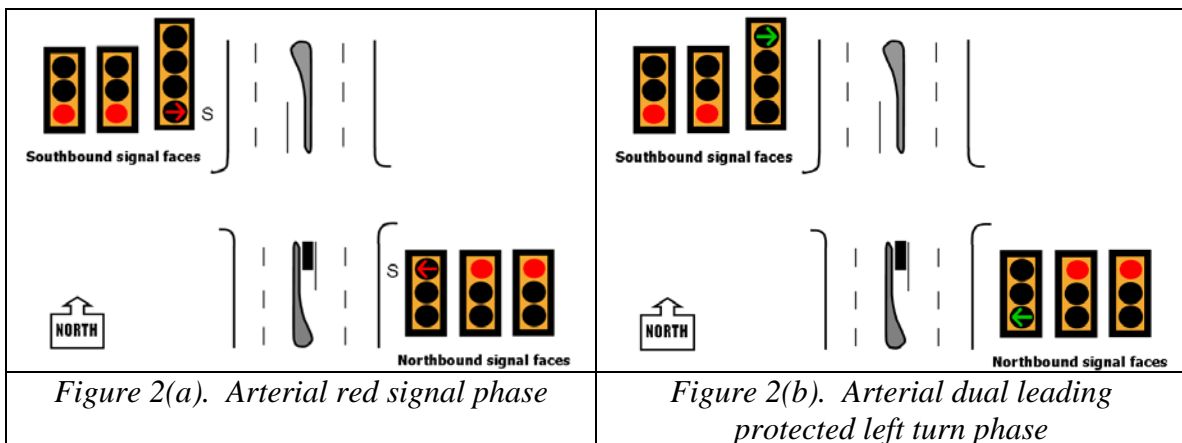
The 2009 MUTCD includes provisions for the use of a flashing red arrow for left turn movements under certain conditions. However, the signal sequence requires the display of a steady left turn yellow arrow following the display of the flashing red left turn arrow indication before the display of a steady red left turn arrow indication. Displaying a steady left turn yellow arrow in the AFRA sequence when the left turn mode is changing between permissive and protected only mode would result in a "yellow trap" for the left turn movement since the opposing through movement has a continuing circular green

indication. The proposed AFRA sequence includes changing from a flashing red arrow to a steady red arrow for the left turn movement without the display of a steady yellow arrow. However, when the signal sequence is progressing from the arterial street to the side street, the AFRA sequence includes a steady yellow arrow for the left turn movement as included in the 2009 MUTCD. No “yellow trap” occurs in this situation since the opposing through movements have a circular yellow at the same time as the steady left turn arrow.

DESCRIPTION OF PROPOSED AFRA SIGNAL SEQUENCE

Figures 2(a) through 2(k) illustrate the sequence of signal indications presented to the northbound and southbound arterial traffic using the proposed adaptive flashing red arrow concept. Figures 2(e) through 2(i) highlight the specific elements of the AFRA sequence concept that use a flashing red arrow indication for permissive left turns.

Note: The figures include an “S” or “F” adjacent to the yellow and red arrow indications in signals heads controlling the left turn movements and containing only arrow indications in order to show whether the arrow is flashing or steady. All green arrows shown are steady indications.



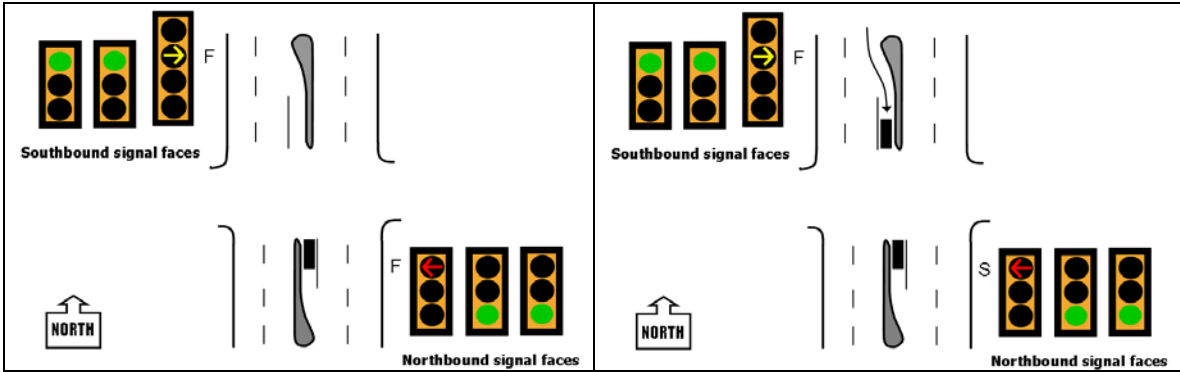


Figure 2(e). Arterial flashing red arrow permissive left turn northbound with no traffic in opposing left turn bay.

Figure 2(f). Arterial steady red arrow protected only left turn northbound with traffic in opposing left turn bay.

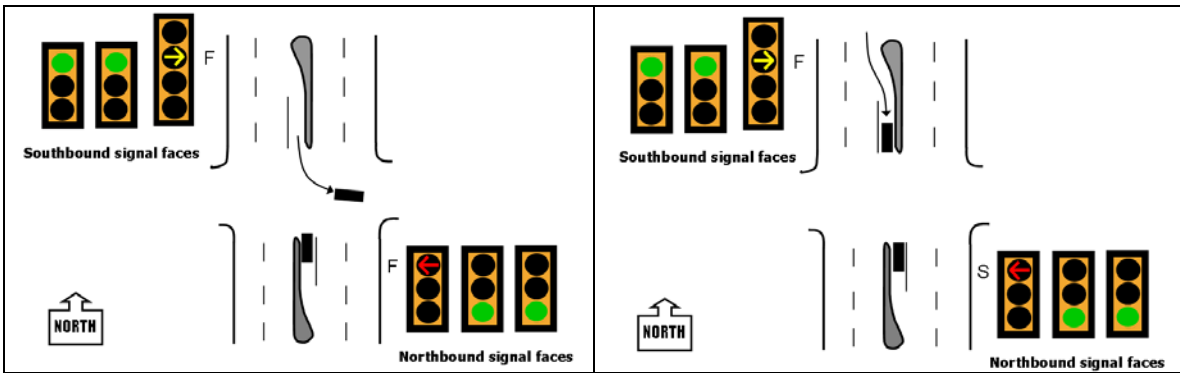


Figure 2(g). Northbound left turn indication returns to flashing red arrow permissive left turn after opposing left turn bay is clear.

Figure 2(h). Northbound left turn indication returns to steady red arrow protected only left turns if additional traffic enters the opposing left turn bay.

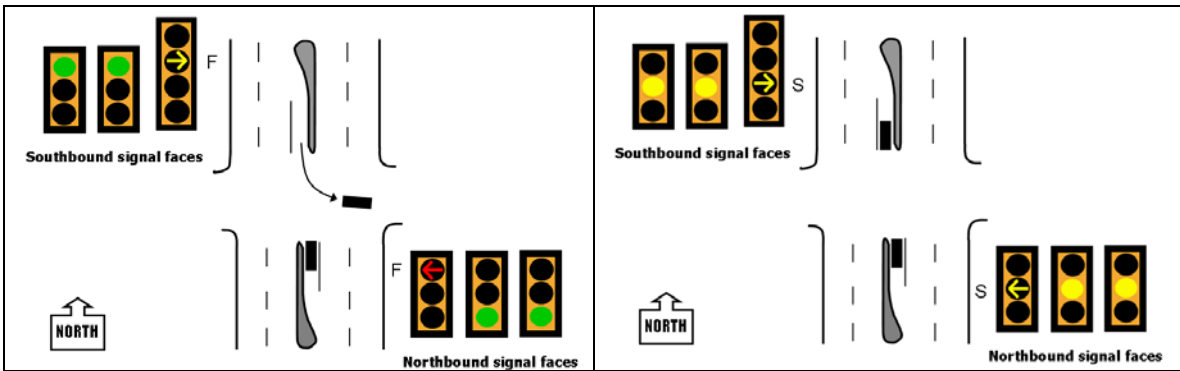
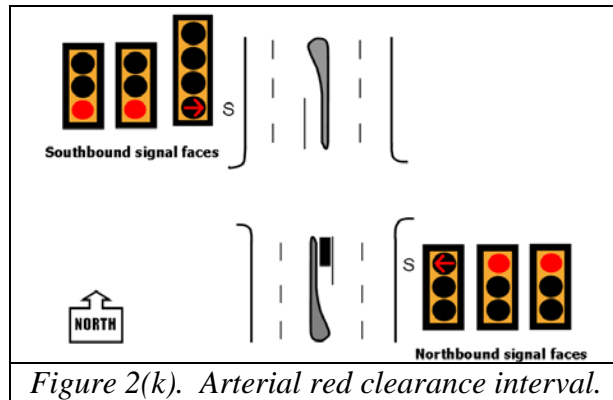


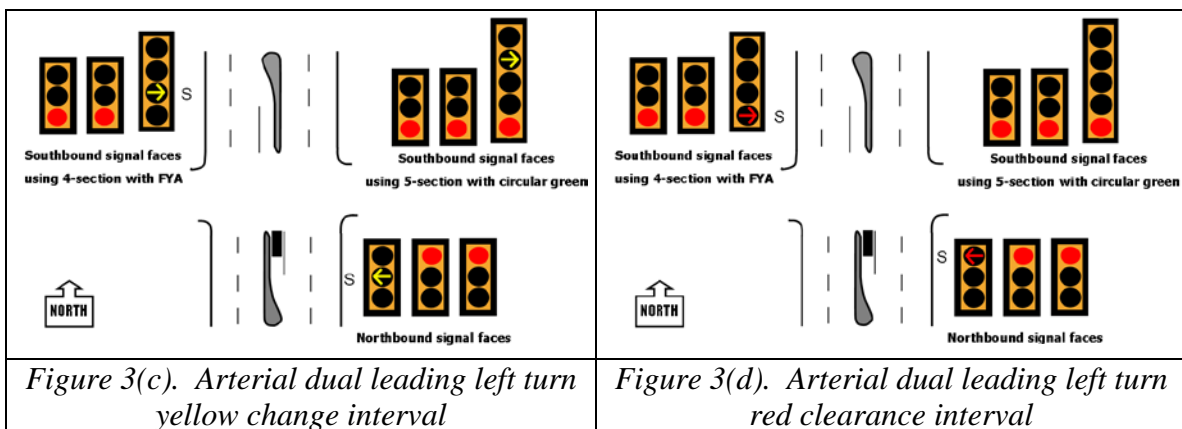
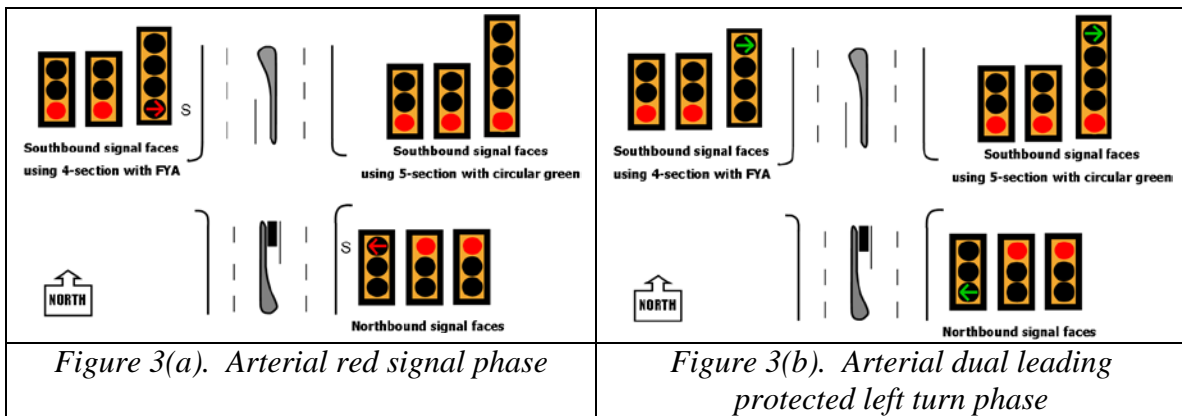
Figure 2(i). Northbound left turn signal indication returns to flashing red arrow permissive left turns as the opposing left turn bay clears.

Figure 2(j). Arterial yellow change interval.



Figures 3(a) through 3(k) present a comparison of the AFRA operation opposite a 4-section FYA signal face versus being opposite a 5-section signal face using a louvered circular green protected/permmissive left turn display. Figures 3(e) through 3(i) highlight the specific elements of the AFRA sequence concept that use a flashing red arrow indication for permissive left turns.

Note: The figures include an “S” or “F” adjacent to the yellow and red arrow indications in signals heads controlling the left turn movements and containing only arrow indications in order to show whether the arrow is flashing or steady. All green arrows shown are steady indications.



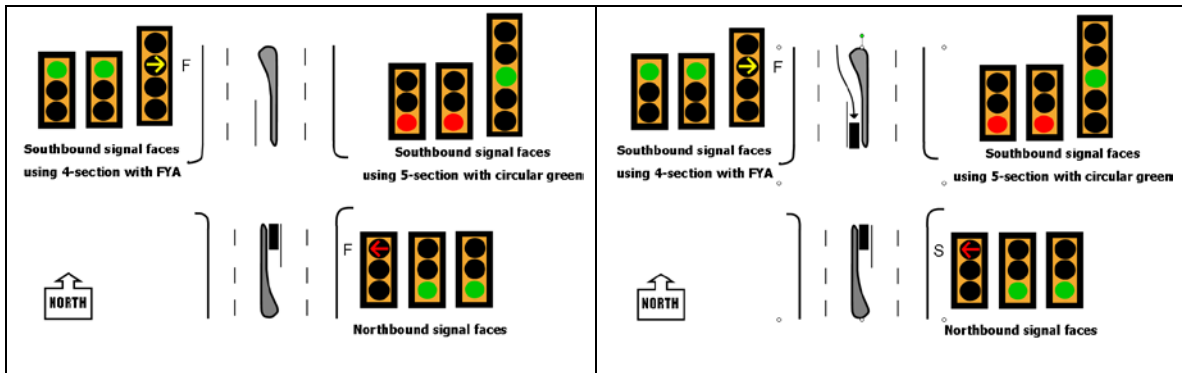


Figure 3(e). Arterial flashing red arrow permissive left turn northbound with no traffic in opposing left turn bay.

Figure 3(f). Arterial steady red arrow protected only left turn northbound with traffic in opposing left turn bay.

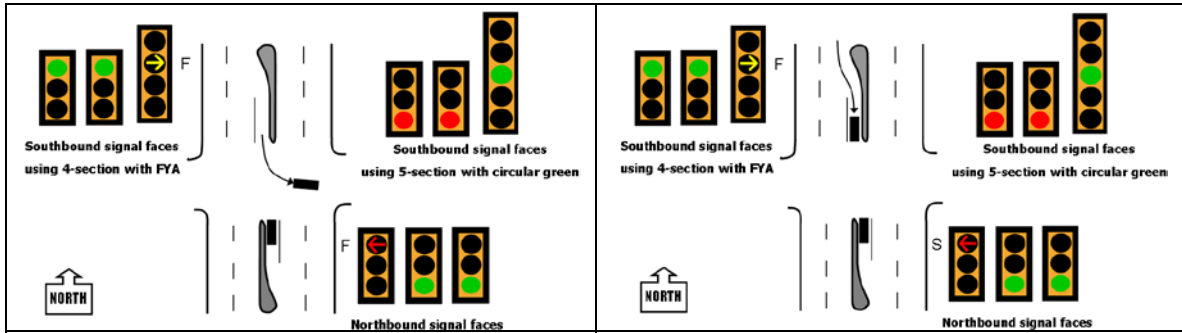


Figure 3(g). Northbound left turn signal indication returns to flashing red arrow permissive left turns as the opposing left turn bay clears.

Figure 3(h). Northbound left turn indication returns to steady red arrow protected only left turns if additional traffic enters the opposing left turn bay

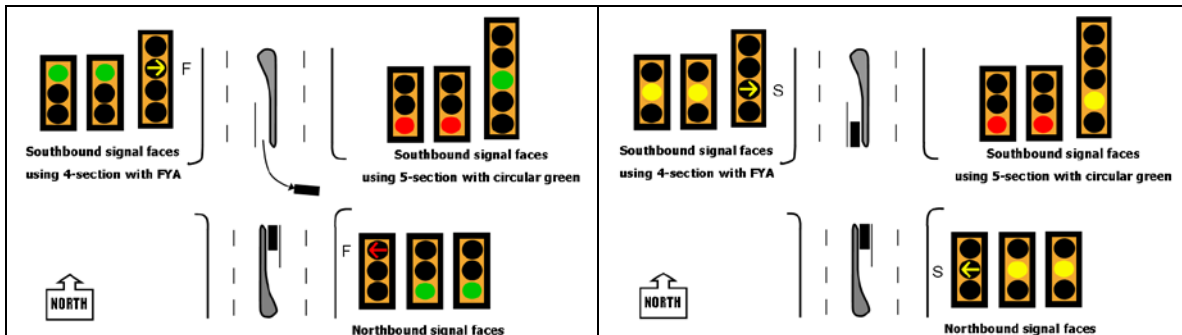
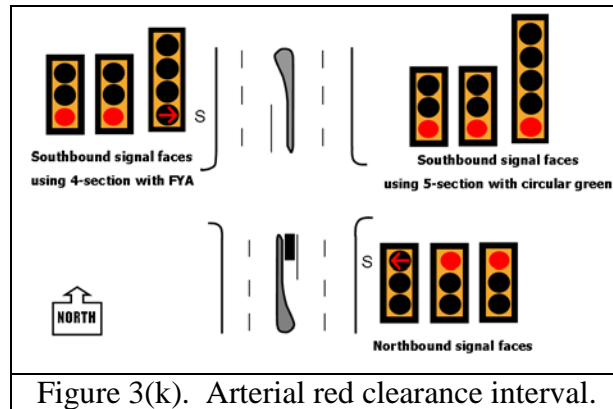


Figure 3(i). Northbound left turn signal indication returns to flashing red arrow permissive left turns as the opposing left turn bay clears.

Figure 3(j). Arterial yellow change interval.



DESCRIPTION OF PROPOSED EXPERIMENT

The proposed experiment will occur in three phases and at two locations. Phase 1 involves videotaping traffic operations at each location under existing facility conditions. Phase 2 will involve a media education campaign to help drivers understand the meaning of the experimental AFRA signal scheme before it is installed. Phase 3 will include installation of the AFRA signal sequence, followed by a multi-week driver adaption time, followed by videotaping traffic operations under the proposed after condition. Accident data for both locations before and after AFRA installation will be collected and compared. Locations for experimental testing have been selected to include existing surveillance video cameras.

During videotaping, the following data will be collected:

- Traffic volume by turn movement, including
- Numbers of left turns during protected and permissive (after condition) signal indications
- Delay for left turn traffic
- Number and type of incidents
- Frequency and type of conflicts

Statistical analysis will be conducted on the data to determine if there are significant differences between data collected during the before (Phase 1) and after (Phase 3) conditions.

LOCATIONS

The AFRA signal indication will be installed at two locations shown below. Test site number 1 will be the intersection of Lamar Blvd and 24th Street with the experimentation for the northbound left turn on Lamar Boulevard. Test site number 2 will be Capital of Texas Highway and Sam's Club Driveway with the experimentation for the eastbound left turn on Capital of Texas Highway.

In the event the City of Austin desires to expand the experimentation of this left turn operation to any additional locations, the City will submit a request to TxDOT listing the proposed additional locations.



Figure 4. Proposed AFRA test site Number 1, Lamar Blvd at 24th St
[Photo from Google Maps]



Figure 5 Proposed AFRA test site Number 2, Capital of Texas Highway at
Sam's Club Driveway [Photo from Google Maps]

TIME OF OPERATION DURING EXPERIMENTATION

Ultimately, we would not anticipate that time-of-day restrictions would be included if this operation proves successful and is incorporated into the MUTCD. The time of operation at a given location would be determined by engineering judgment. However, since this type of left turn operation will be new to road users, it is proposed that the operation initially be limited to times between 7 P.M. and 6 A.M. If no adverse operations are observed, the operation would be expanding to include times between 9 A.M. and 3 P.M. Again assuming no adverse operations are noted, the operation would be tested during peak hours as well.

SCHEDULE

- September-October 2011: PHASE 1 –Collect data to establish “before conditions.”
- November-December 2011: PHASE 2 – The City of Austin leads a one-month advertising/education campaign assisted by local media.
- January 2012: PHASE 3 - The City of Austin installs the AFRA signal timing plans at each location and provides at least two weeks for driver adaptation before beginning collection of after data.
- February-August 2012: Collect data on the “post-education after conditions.” This will include accident records and since six months is considered a minimum observation time for accident data observation, the time encompasses six months.
- September-October 2012: Compile all data, evaluate results, present to City of Austin and TxDOT, and provide the FHWA with a detailed report and evaluation of the experiment.

PATENT OR COPYRIGHT

To the best of our knowledge the concept of the AFRA is not protected by a patent or copyright.

REMOVAL OF EXPERIMENTATION INSTALLATION

The City of Austin agrees to terminate the experiment at any time that the City determines significant safety concerns are directly or indirectly attributable to the experiment. The City of Austin agrees that the FHWA has the right to terminate the approval of the experimentation at any time there is an indication of a safety problem and, should such termination occur, the City agrees to abide by that decision. The City of Austin agrees to restore all experimental sites to pre-experiment conditions within three months following the completion of the experiment unless the device demonstrates an improvement and a request is made to change the MUTCD to include this device and an official rulemaking action occurs.