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16. Abstract Attendance at large arena events is increasing, as the seats are added, and ground level activities such as tailgating attract visitors not attending the game. Access is somewhat staggered as people choose their arrival times differently. However, the egress is far more concentrated with visitors largely attempting to leave simultaneously. The prevailing approach is to place police officers, who communicate via radio, at proximate exit locations. Further complicating the egress are those who arrive by public transportation and are transported by scheduled train cycles or queued buses. Once filled, users wait for the next cycle. Given advances in technology from the perspective of handheld devices and traffic management software, it is timely to reexamine protocol and strategies to determine whether an opportunity exists to facilitate or streamline egress, specifically looking at NRG Stadium in Houston. This work convened stakeholders familiar with NRG stadium in Houston, Texas to detail concepts to potentially improve egress, particularly in consideration of Super Bowl XLIX to be held at NRG in 2017.					
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**A Synthesis Report of Purpose and Need: Assessment of Event Egress for
Houston's Reliant Stadium**

by

Carol Abel Lewis, Ph.D.
Professor and Director, CTTR
and

Latissha Clark, Assistant Researcher

Velyjha Southern, Graduate Student Assistant

Research Report SWUTC/15/600451-00049-1

Southwest Region University Transportation Center
Center for Transportation Training and Research
Texas Southern University
3100 Cleburne
Houston, Texas 77004

December 2015

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ABSTRACT

Attendance at large arena events is increasing, as the seats are added, and ground level activities such as tailgating attract visitors not attending the game. Access is somewhat staggered as people choose their arrival times differently. However, the egress is far more concentrated with visitors largely attempting to leave simultaneously. The prevailing approach is to place police officers, who communicate via radio, at proximate exit locations. Further complicating the egress are those who arrive by public transportation and are transported by scheduled train cycles or queued buses. Once filled, users wait for the next cycle. Given advances in technology from the perspective of handheld devices and traffic management software, it is timely to reexamine protocol and strategies to determine whether an opportunity exists to facilitate or streamline egress, specifically looking at Reliant Stadium in Houston. This work convened stakeholders familiar with NRG stadium in Houston, Texas to detail concepts to potentially improve egress, particularly in consideration of Super Bowl XLIX to be held at NRG in 2017.

EXECUTIVE SUMMARY

Access and egress from major arenas for events is often known to be congestion prone and otherwise not easily negotiated. Egress is far more concentrated than access with visitors largely attempting to leave simultaneously. The prevailing approach is to place police officers, who communicate via radio, at proximate exit locations. A review of procedures for NRG Stadium in Houston can serve as a case study to assess state-of the practice nationwide, determine the baseline existing condition for Houston and propose next steps to update and improve the visitor transportation experience, if warranted.

Reports from the recent 2014 Super Bowl XLIX in New Jersey indicate that some attendees using transit waited up to 3 hours after the game ended to exit. Transit riders were asked to remain in the stadium as the train platforms were overly crowded with extremely long waits. Houston will host the 2017 Super Bowl XLIX at its NRG Stadium. The work done by others will provide a solid foundation to study potential improvements in preparation for the regular events and the Super Bowl.

This work assembled key stakeholders to discuss their perspective of traffic and transportation relative to Super Bowl XLIX. The outcomes yielded a cadre of concepts that may be explored in greater depth by the transportation entities responsible for traffic and transportation for the 2017 Super Bowl. Ideas include, but are not limited to the following:

- Unlike the attendees of typical NRG events, the majority of Super Bowl attendees will not be local and less inclined to access the stadium by driving a personal vehicle.
- Good transit access is paramount; reduce light rail headway to as short as possible and consider providing a bus only access/egress lane.
- Use color coding to direct attendees to appropriate exits and modes and staggering pathways to manage the volume of egress from each exit point.
- The idea of after game tailgating was offered to stagger egress times of attendees. Must consider staffing issues and law enforcement as part of this concept.

It can be expected that local traffic will be less than average Sunday as people avoid travel and hold their own Super Bowl parties.

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BACKGROUND

Access and egress from major arenas for events is often known to be congestion prone and otherwise not easily negotiated. Egress is far more concentrated than access with visitors largely attempting to leave simultaneously. The prevailing approach is to place police officers, who communicate via radio, at proximate exit locations. A review of procedures for NRG Stadium in Houston can serve as a case study to assess state-of the practice nationwide, determine the baseline existing condition for Houston and propose next steps to update and improve the visitor transportation experience, if warranted.

Recent conference proceedings have reported on studies of event arenas and stadia from several perspectives. Binny et al. (2014) report that stadia and events projects are different than general public transit and require different modeling approaches. At the same conference, Ni, Hing and Gao (2014) examined improvements that can be achieved using social media. Wolshon spoke at a recent evacuation conference about the initial stages of research to determine whether traffic signals can be timed to mimic the timing strategies of police officers when directing exits from Louisiana State Football games. Other work has focused on whether changes in protocol are required in case of an emergency or terroristic threat. Still others specifically focus on natural disasters, terrorism, crowd control problems, and other large-scale threats. Their work offers insight to better handle high volume events (US Dept. of Homeland Security, 2012; Matherly, 2014).

Reports from the recent 2014 Super Bowl XLIX in New Jersey indicate that some attendees using transit waited up to 3 hours after the game ended to exit. Transit riders were asked to remain in the stadium as the train platforms were overly crowded with extremely long waits. As people waited, they were offered the opportunity to visit the lounge in the interim (Heyboer, 2014). Houston will host the 2017 Super Bowl XLIX at its NRG Stadium. The work done by others will provide a solid foundation to study potential improvements in preparation for the regular events and the Super Bowl.

This work assembled key stakeholders to discuss their perspective of traffic and transportation relative to Super Bowl VI. The outcomes will yield a cadre of concepts that may be explored in greater depth by the transportation entities responsible for traffic and transportation for the 2017 Super Bowl.

A transportation analysis of the area is an element to be considered for any special event held at NRG Stadium (NRG). Special event planning and egress can differ greatly according to event type. Preparations for egress are dependent on the anticipated attendance and type of event. Some examples of various event types are: High School and College Football games (such as high school play offs and bowl games), The Houston Livestock Show and Rodeo, and Concerts. The plans are evaluated and modified base on events type, and regional hazards common to the city, county, regional, and state. A review of literature shows much research in the area of evacuation for emergencies, but not as much to improve regular egress. Each evacuation plan has an element for transportation planning. The base plan utilizes a template in according to the National Incident Management System (NIMS). With a large number of special events held at NRG, there are several potential scenarios that can be considered. Traffic analysis can provide an

opportunity to also evaluate, address, modify, or create an emergency stadium egress protocol. NRG is a complex including the stadium, the Center, the Arena and the Astrodome, along with several parking locations (Figure 1).



Figure 1. NRG Park Layout

NRG will host the 2017 Super Bowl; attendance of the previous Super Bowls ranges from 70,000 to approximately 103,000. The NRG stadium seating capacity is 71,500. Homeland Security Exercise and Evaluation Program (HSEEP) templates can provide a base level foundation in egress planning from the lot. Once off the lot, smooth, consistent flow is desired for people in private vehicles and on public transportation. Some questions for consideration in egress planning are as follows:

- What is the anticipated amount of attendees?
- What agency(s) control the streets, highways, mass transit systems, as well as other transportation systems in the area of the stadium? City, County, State, Law Enforcement, or/and Department of Transportation?
- How will pedestrian and vehicle traffic exit from the exterior perimeter of the location?
- Are there designated corridors for movement of traffic (pedestrian and vehicles)? Are there separate routes for pedestrian and vehicle traffic?
- What controls are in place to maintain traffic flow?
- Is it possible that planning for a Special Event is similar to the Emergency Evacuation strategies?

Examples of Guidance: San Diego and New Jersey

San Diego – A special event planning guide is offered by the city of San Diego in order to streamline how each special event occurs. It uses a standardized template, but amendments are allowed. The forms provide information about how to use right of way for safety, barricades, and directional signage. It also states that the city does not provide any equipment for events. Under the section dedicated for traffic control, a template is included for the security operational plan. This includes the safety and transportation issues of participants and attendees at the event. The organizers must provide what if scenarios for the venue and submit the preplan to the police department. The plan could include additional amendments as required by the San Diego Police department.

New Jersey – New Jersey provides definitions as well as guidance in preparing for egress situations. The term is defined as: an acceptable and continuous uninterrupted flow of a pathway from a facility or right-of-way. There are over 10 categories of egress from various situations. For example, passageway corridors and fire exits. These are not all inclusive forms of egress for New Jersey. The handbook provides notes on the weight allowed as well as proper space for each individual access. There are exceptions to these regulations however an amendment must be submitted with egress plan.

New Jersey Transit (NJT) received a large amount of criticism due to its inability to move large numbers of people during a special event. Super Bowl XLVIII (2014) an American Football game, held at Meadowlands Stadium in New Jersey had problems in public transit egress at the games' end. Attendees of Super Bowl XLVIII waited in long lines to leave the stadium and events held in the area. Having being dubbed the "First Mass Transit Super Bowl," attendees began having transportation problem before arriving at the stadium. These issues continued after the event ended.

To aid in the egress from the stadium buses from Manhattan were arranged to pick up passengers. The typical time as stated by an attendee "You can get out of any stadium in 45 minutes to an hour. We are at three hours just to get here," said Terry Thon, of Denver. Once arriving at the transfer station there was another 45 minute wait. NJT transported three times as many attendees than a regular New York Giants football game. Over twenty-eight thousand (28,000) tickets were purchased which shattered previous transit ticket sale records and overwhelmed the transit system (Heyboer, February 3, 2014).

Other work – There is a concentration on the emergency egress, but very limited studies of non-emergency research. The article "*Mobility Management and Travel Behavior: How TDM Changes Travel Behavior*" presents findings that an increase use of transit vehicles and High Occupancy Vehicles (HOV) relieved strain on the transportation network in London. The 2012 London Olympics increased the travel demand on the transportation network by an additional 55,000 people a day. This additional increase was along some of London's most congested roadways with demand equivalent to additional need of 108 miles of roadway space. The increase need of roadway space created a plan for alternate mobility options to be developed. In effect, the creation of various mobility options provided a long term benefits to the area. Travel

warnings, traffic signal adjustments and emphasis on transit measures were options to relieve the traffic congestion. Emphasis on transit related options eased the travel base load on roadways.



Figure 2. NJ Super Bowl XLIX Attendees Awaiting Public Transportation Egress

Enacting the preplan mobility options reduced the travel base load and allowed traffic flow to efficiently move the increased demand.

“Traffic Management of Special Events in Small Communities,” (Lassacher, 2014) identifies strategies to address the congestion issues facing Montana State University (MSU) as the result of planned special events (PSEs). The study provided concepts of modified traffic plans that can impact traffic egress congestion. Though the setting is a small community, it is suggested that these parameters may also be helpful in an urban environment. Ideas to consider include the following.

- Real Time Traveler Information
- Road Closures
- Traffic Signal Timing
- Real time Traffic Monitoring with use of Closed Circuit Televisions (CCTV)

Successful strategies all recommend strong interagency partnerships and active communication with stakeholders to identify and address anticipated congestion.

METHODOLOGY

The focus of this work is to conduct a discussion of key area stakeholders to delineate potential strategies to alleviate egress from NRG stadium after the Super Bowl. The strategies may also be useful for consideration for the Houston Livestock Show and Rodeo and other NRG events. Steps to conducting the discussion session include the following:

- Assemble and synthesize literature in preparation for the Power Point Presentation and brochure.
- The team prepared a Power Point presentation and brochure paper based on the Task 1 synthesis to inform the attendees and set the agenda setting for the stakeholder discussion.
- Execute discussion meeting logistics and conduct the stakeholder discussion. Stakeholders directing involved in traffic and transportation planning and management for the NRG Complex were invited to a seminar to discuss the synthesis finding and options for egress improvements.
- The synthesis report with attendee comments was prepared.

SUMMARY OF DISCUSSION

Attendees at the December 3, 2015, discussion included representatives of the City of Houston, Harris County, Texas Department of Transportation (TxDOT), Houston TranStar and the Houston Livestock Show and Rodeo (Appendix 3). Texas Southern University's Center for Transportation Training and Research began with the session introduction, an overview of the purpose and desired outcomes, and the description of the format as an informal exchange of thoughts (See Appendix 4). It was noted that Super Bowl and NFL officials have primacy in all event decisions. Brainstorming commenced; concepts for consideration are below.

- A point of consideration is that State Highway 288 will likely be under construction at the time of the Super Bowl. The route, Fannin to Old Spanish Trail to SH 288, is a primary egress route. Under construction will be managed lanes down the medium.
- Unlike the attendees of typical NRG events, the majority of Super Bowl attendees will not be local and less inclined to access the stadium by driving a personal vehicle.
- Good transit access is paramount.
- Liberally use color coding to direct attendees to appropriate exits and modes. Focus on cataloging groups, so no lot or walking path streams are crossed; each lot and pedestrian pathways are aligned (if you're parked here – this is your egress route).
- Consider staggering stadium exiting; use color coding for varying modes (person vehicle and arterials and public transportation); combine this strategy with elongating time refreshment stands are open.
- The idea of after game tailgating was offered to stagger egress times of attendees. Must consider staffing issues and law enforcement as part of this concept.
- Reduce light rail headway to as short as possible – at a minimum from current six (6) minute headways to four (4) minutes or so.
- It can be expected that local traffic will be less than average Sunday as people avoid travel and hold their own Super Bowl parties.
- Consider whether an Uber zone should be created.
- An additional parking location could be available on Houston Livestock Show and Rodeo (Rodeo) property, immediately south of the stadium and across from NRG. An exception would be needed from the Harris County Appraisal District in regards to the Rodeo's tax exempt status.

- Create bus only lanes for the Metropolitan Transit Authority Park and Ride buses on Holly Hall Lane. Buses could access SH 288 via Holly Hall Lane to minimize integration with traffic on Fannin.
- Manage queuing for light rail vehicles to avoid the bunching observed in Figure 2. Orderly queues of people leaving the Rodeo begin almost at the stadium, with rider separating into northbound and southbound lines separated by ropes from people who are not riding the train. It was noted that the Rodeo engages a team of volunteers that communicate with visitors and assist with tasks, such as METRO riders lining appropriately. A similar volunteer team might assist Super Bowl attendees.
- CTTR staff logged travel time observations about traffic movements along IH 610 after several Houston Texan Football games (slides in Power Point Presentation). An interesting point seemed to be that traffic clogs began along IH 610 West near the Uptown and Galleria areas. There was discussion as to whether attention should be paid to this bottleneck point to facilitate flow from NRG stadium after events. Consensus of the group was that improvement underway for US 290 may alleviate that bottleneck once construction is completed.
- An idea was advanced to utilize the Union Pacific (UP) tracks that are east of the NRG stadium for access and egress. In order to move this idea forward, the following should be answered.
 - Is there demand to justify the idea. Riders would come from Richmond/Rosenberg, Sugar Land. With the majority of visitors from out of town, it is anticipated concentration will be in Downtown, Uptown and other hotels on the west side of the city.
 - Would UP say yes?
 - What would cost be?
 - What is the track condition; would it be suitable for passengers.
 - If the transfer location is Fannin South, would overcrowding occur with train volumes are meshed with the people parking there. If the terminal location is not Fannin South, buses would still be needed. If bus is needed for final distribution, one may as well take the bus for the entire trip duration. Get that information out to medial
- Create Apps that show visitors how to exit.

Next Steps

This Final Report of the NRG Egress discussion session will be forwarded to all discussion attendees, METRO and the Office of County Judge Ed Emmitt. As those in attendance participate in planning meetings to come, some concepts may be deemed important for consideration.

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APPENDIXES

Appendix 1



TEXAS SOUTHERN UNIVERSITY

*3100 Cleburne
Houston Texas*



November 23, 2015

You Are Invited

The Center for Transportation Training and Research (CTTR) at Texas Southern University conducts research for operational and policy focused mobility improvements. A grant received from the Southwest Region University Transportation Center, a USDOT consortium including TAMU and UT, will fund a discussion symposium regarding NRG egress in anticipation of the 2017 Super Bowl. We recognize that professionals from NRG and governmental agencies have existing plans in place and will work intently as the time for the Super Bowl approaches. CTTR wishes to provide an academic view of event egress and potentially stimulate additional solutions by hosting a discussion on December 2, 2015.

We will meet in the *Science Building (165 on the map)* or *Technology Building (163 on the map)* on the campus of Texas Southern University at 10 a.m. and will conclude before lunch. The specific building and room number will be forwarded in the coming days. Parking is in the garage at the corner of Blodgett and Ennis (122 on the map), enter from Blodgett.

We hope you will join us and will send an Outlook invitation confirming details, facilitating your acceptance or letting us know you'll be unable to attend.

Appendix 2 NRG Brochure



NRG Egress: FOCUS SUPER BOWL LI

Scope and Dynamics

The purpose of this project is to identify effective transportation practices that will allow key stakeholders to manage traffic flow after major events that occur at NRG Stadium.

With the City of Houston scheduled to host Super Bowl LI at the NRG Stadium February 5, 2017, traffic management will be critical. Roughly 700,000 people attend the Super Bowl each year and more effective options are needed to manage travelers. Super Bowl LI will draw hundreds of thousands of spectators from outside the city. Managing the flow of traffic for residents and visitors is critical to reduce congestion, and longer than usual commutes back to attendees' destinations.

Study Methodology

- Identify transportation errors from past major events that have occurred in other geographical locations.
- Explore successful, credible solutions in regards to egress after major events.
- Project the average number of spectators attending NRG Stadium for events.
- Identify key stakeholders that will play a major role.
- Develop additional egress ideas for major events occurring at NRG Stadium.

Discussion Options

- Identify alternative routes that can lessen traffic congestion and reduce bottlenecks.
- Encourage bus and rail ridership to reduce the number of vehicles on the roadway.
- Work closely with TranStar to monitor the flow of traffic, to swiftly remove accidents and clear additional highway issues.
- Consider traffic light synchronization.
- Consider bus only lanes for a swifter passenger commute.

NRG Stadium Facts

- Houston Texans football games produce an average 574,132 attendees annually and an average 71,766 fans per home game.
- College football games on the division one level produce an average of half a million fans at the stadium each year.
- The Houston Livestock Show & Rodeo produces 2.4 million attendees annually. On a daily basis, the rodeo produces anywhere between 53,547 to 174,507 visitors.



Center For Transportation Training & Research (713) 313-1925

Appendix 3
List of Attendees

Name	Agency
Carlton Allen, P.E.	Houston TranStar
David Fink, P.E.	Houston TranStar
Nick Harris, P.E.	Harris County Engineering Department
Sherry Hibbert	Houston Livestock Show and Rodeo
James Keener	Texas Department of Transportation
Barbara Russell , P.E.	Texas Department of Transportation
Matt Tangen, EIT	Harris County Engineering Department
Jeff Weatherford. P.E.	City of Houston Public Works and Engineering
Carol Abel Lewis, Ph.D.	Center for Transportation Training and Research
Velyjha Southern	Center for Transportation Training and Research

Appendix 4 PowerPoint Presentation

NRG Egress
Focus Super Bowl LI

Discussion
Texas Southern University
Center for Transportation Training and
Research

December 2, 2015

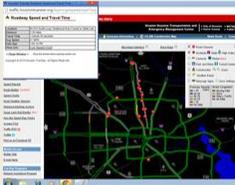
Discussion Outline

- Motivation for this session
- Iteration of traffic problems
- Options beyond those currently in use for addressing traffic problems
- Wrap-up
TSU staff will prepare a technical report and forward to all attendees

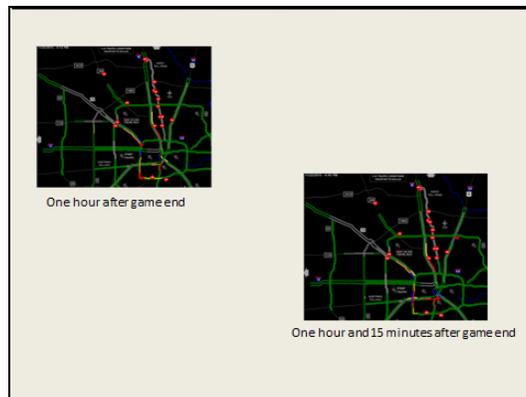
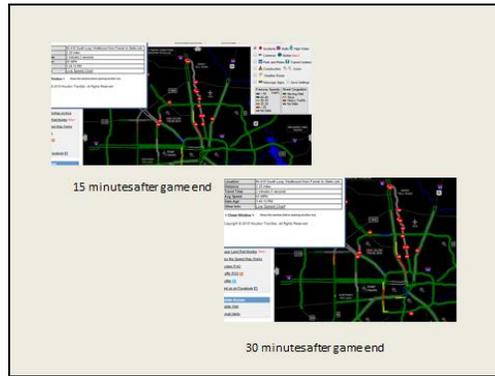
Options

- Identify distant bottleneck and address congestion at point furthest from NRG
- Bus only lane from NRG
- Option to use UP for rail along 90A

Time Lapse Egress Texans Game



Two minutes left in the game



Options

- Identify distant bottleneck and address congestion at point furthest from NRG
- Bus only lane from NRG
- Option to use UP for rail along 90A

Note: Time lapse TranStar Images were taken for select games in 2013, 2014 and 2015. The images show traffic generally building on IH 610 before congestion occurs closer to the stadium. Future research may focus on the point of an upstream bottleneck to better absorb congestion contiguous to the stadium.