

**Metropolitan Area Transit Authority  
Board Action/Information Summary**

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**Fatigue Risk Management System Update**

**PRESENTATION SUMMARY**

The Committee will be updated on the actions completed since the last Committee report in July on the development of a Fatigue Risk Management System (FRMS). Over the course of the first phase of this program WMATA has worked with the Institute for Behavior Resources (IBR) and Mr. Grady Cothen to identify the safety critical employees; complete a comprehensive study on Bus Operations modeled after the Tri-State Oversight Committee (TOC)/WMATA format used for the Rail Operations study; complete a hazard assessment of rail and bus safety sensitive employees; establish an Executive and Operational Committee for the FRMS project; and complete an initial bio-mathematical analysis of rail and bus operator data on hours worked.

**PURPOSE**

The Committee will be informed of the milestones reached and research findings gained through the development of the FRMS program thus far.

**DESCRIPTION**

In building upon last year’s findings from the Joint Fatigue Study on Rail Operations with TOC, Management, working with union representatives and consultants IBR and Mr. Cothen, concluded the Hazard Assessment of Rail and Bus Safety Critical Employees; completed the final draft of the Bus Operations Study; are currently in progress of drafting the report on MetroAccess; conducted an initial sampling of the Fatigue Avoidance Scheduling Tool (FAST) using actual hours worked of bus and rail operators; and established the Executive and Operational Committees to manage the initiative.

**Key Highlights**

- Through the ongoing program the Authority has been able to identify that actual hours worked is not the sole factor affecting employee fatigue, but rather there are many elements that must be considered when limiting the potential for effects of fatigue in employees. Some factors include lifestyle changes, the time of day that an employee works, awareness of the effects of

- fatigue on one's body, changes in working environments that will promote and provide the opportunity for rest, better scheduling software, etc.
- As outlined in the August 17 board memo, the SAFTE-FAST modeling system was used to model the level of fatigue in WMATA safety sensitive employees. During the month of April, 2012, a fatigue analysis was conducted on 537 rail operators and 2,480 bus operators. Rail operator fatigue was limited to a group representing approximately 6%-7% of the sample work force who worked large amounts of time at night. Bus operator fatigue was limited to 0.4% of the sample work force who had very early start times between 0300 hours-0500 hours. The study found that one measure that could mitigate the fatigue was an earlier bedtime of 2200 hours, which provided sufficient sleep prior to these shifts.
  - The FAST modeling shows that total work hours per week or month have little influence on fatigue. An Hours of Service (HOS) policy that limits the amount of work per day will not address either of the two sources of fatigue noted having to do with night work or early morning starts.
  - Work continues to model the fatigue of other work groups and to define effective work and rest policies that consider time of day of work.

**Background and History** — Contemporary science tells us that fitness for duty depends on being well rested, and experience teaches us that when effectiveness is undermined by insufficient sleep, safety can be directly compromised. Further, chronic sleep loss and medical conditions that adversely affect our ability to obtain quality sleep are deleterious to good health. Therefore it can be shown that chronic fatigue can overtime deteriorate the health of an individual, and possible shorten one's lifespan.

With this background and consideration of developments in sleep science, NTSB recommendations, data from other modes of transportation, and program experience in aviation and other sectors, an integrated, comprehensive and scientific approach was warranted. Fatigue is part of our everyday lives, and no employer can eliminate fatigue from the workplace. But we can implement measures to prevent and mitigate fatigue, including an emphasis on personal responsibility that is enabled by education and training. Using a science-based approach, we are initially focusing on safety-critical occupations, emphasizing those jobs that involve the greatest risk to the public and co-workers, as determined through a hazard assessment. Afterward, work will proceed to address the remaining safety-sensitive occupations.

On November 17, 2011, the Committee was briefed on the findings of the joint TOC/WMATA fatigue management study. We identified gaps in the Authority's programs and policies that caused a minority of employees to work excess hours and noted missed opportunities to prevent or mitigate fatigue. Using the TOC/WMATA format we conducted and completed a similar survey of Bus Operations, and are

currently compiling or reviewing the results collected from a survey of MetroAccess with the final draft report being edited for publication over the next few weeks.

Accordingly, WMATA will work to prevent and mitigate fatigue and promote optimal alertness and vigilance by establishing and maintaining a Fatigue Risk Management System (FRMS), acting within the framework of the System Safety Program Plan, and with special focus on safety-sensitive WMATA and contractor personnel. The FRMS will ensure to incorporate the following principles:

- Providing working conditions that support the prevention and mitigation of fatigue, undergirded by appropriate education and training;
- Encouraging employees and contractors to take advantage of opportunities for sleep, and WMATA managers and supervisors will model appropriate work/sleep behaviors in the interest of a positive safety culture;
- Limiting the numbers of hours worked based on scientific knowledge regarding the effects of sleep loss and normal body clock ("circadian") phases;
- Continuing to develop a medical fitness-for-duty program that includes protocols for identification and management of sleep disorders among safety-sensitive employees;
- Making adjustments periodically based upon review of data defined by program metrics and safety results, as evidenced by accident rates and investigatory findings for accidents and precursor events; and
- Improving the existing Fatigue Awareness campaigns to ensure a more comprehensive program is generated.

April work hours for rail and bus operators were processed through the SAFTE-FAST fatigue model. Trapeze schedule data for a random sampling of 537 rail operators and 2480 bus operators from April 2012 was used for the model. In order to gain an accurate depiction of the level of fatigue in the sample group the following assumptions were made:

- Fast Model Assumptions:
  - Bedtime: 2300 hours
  - Max workday sleep: 8 hrs
  - Max rest day sleep: 8.5 hrs
  - No sleep zone: 1300 hours-1900 hours
  - Transition/Commute: 90 min
  - Critical Hours: midnight to 0800 hours

The results indicate relatively little fatigue in these two groups and what was found was not the result of excessive total hours of work.

- For rail operators the fatigue analysis showed the following:

- 93% of operators' work hours do not create fatigue that exceeds the Federal Railroad Administration (FRA) criterion for mitigation – more than 20% of work time is below a level of 70 effectiveness.
  - Through Dr. Hursh's method it has been proven that there is a reliable linear relationship between effectiveness and the risk of a human factors accident. An elevated risk of human factors accidents is seen at any effectiveness score below 90, and accident risk increases as effectiveness decreases. The risk of a human factors accident is increased significantly at effectiveness scores at or below 70. Based on other research, an effectiveness score of 70 is the rough equivalent to being awake for 21 hours following an 8-hour sleep period the previous night.
- Between 6% and 7% of operators exceed the criterion, depending on sleep assumptions.
- The major cause of this fatigue is the large amount of work time between midnight and 0800 – greater than 90 hours per month – which aligns most work with the period of circadian low and deprives these operators of good quality sleep. We will be evaluating the nature of these duties in order to develop a mitigation strategy.
- For rail operators, there was, at most, a very mild relationship between total work hours per month and fatigue. Hence, limitations on total hours worked per week or per month will do little to reduce fatigue.
- Likewise, limiting total hours worked per day may have some beneficial value but will not address the fatigue generated by high levels of night work in a small fraction of this group.
- For bus operators the fatigue analysis showed the following:
  - Overall, only 0.4% of bus operators' work hours create fatigue that exceeds the FRA criterion.
  - The majority of that fatigue is caused by early morning starts (0300 hours-0500 hours) and would be mitigated by advancing bedtime to 2200 hours.
  - Only 0.16% of operators with excessive fatigue would not be mitigated by this countermeasure.
  - For these operators, there was, at most, a very mild relationship between total work hours per month and fatigue. Hence, for the employee groups examined thus far, limitations on total hours worked per week or per month will do little to reduce fatigue as defined by the biomathematical model employed in this analysis.

In July 2012 we reported that an analysis would be completed on Automatic Train Control workers, On-track equipment operators and electric power employees in order to begin a 14 hours worked, 10 hours off HOS policy; however, through the data collection process we found it difficult to extract the information needed from PeopleSoft to perform the bio-mathematical modeling of these employees. We found

that Peoplesoft did not provide the level of detail that we were able to extract from Trapeze in order to conduct an accurate modeling of the sample hours provided. The 14/10 HOS was implemented in April 2012 for ATC. Although we are aware that hours of Service is a component of fatigue management and a more robust program will be needed to mitigate the issue of fatigue in employees, as a precautionary method we will continue the HOS policy until we are completed with developing the data provided so that an accurate model can be performed.

**ALTERNATIVES**

None

**FUNDING IMPACT**

TBD

**TIMELINE**

<p><b>Previous actions</b></p>	<p>Nov 2011 – TOC/WMATA Joint Fatigue Study on Rail Operations was released to the Safety and Security Committee          February 2012 – Beginning of the Bus Operations and MetroAccess Fatigue Study          July 2012 – Introduction of the FRMS project to the Safety and Security Committee          September 2012 – Conclusion of the Hazard Assessment of Rail and Bus Safety Critical Employees          October 2012- Creation of the FRMS Executive and Operational Committees          November 2012- Introduction of the logbook survey and background questionnaire to the operational and executive committee          November 2012 – First sample of the Fatigue Avoidance Scheduling Tool (FAST) modeling.</p>
<p><b>Anticipated actions after presentation</b></p>	<p>December 2012 – Completion of the Bus Fatigue Studies          December 2012 – Begin next phase of the Employee Awareness Campaign to increase awareness and obtain voluntary participants for the Logbook Survey          January 2013 – Begin the Logbook surveys          February 2013 – Conduct data collection with logbooks and surveys          June 2013- Update of the FRMS to the Safety and Security Committee</p>

**ELECTRONIC ATTACHMENTS**

None.

**OTHER SUPPORT MATERIALS**

Memo - August 17, 2012- Safety Critical Positions

**RECOMMENDATION (for Action Items only)**

None.



# Fatigue Risk Management System (FRMS) Project

Safety and Security Committee

December 6, 2012



# Fatigue Risk Management System Building Blocks

- HOS Policy
- Accident Analysis Methodology
- Sleep Disorders Policy
- Fatigue Countermeasures

Data Collection  
(Pre & Post  
intervention)

- Biomathematical modeling
  - Accident Analysis
  - Existing schedules
  - Dashboard
  - Auto-sleep customization
- Fatigue reporting & root cause analysis

## Building Blocks of an FRMS

### Policies and Procedures



### Organization and Personnel



### Tools and Methods



### Training and Publicity



- WMATA personnel
- FRMS organization and linkages to other departments
- FRMS roles and responsibilities

- Computer based training
- Education on new policies
  - HOS
  - Sleep Disorders Treatment
  - Fatigue countermeasures
- Publicity regarding FRMS program



# Metrorail Joint Fatigue Study

- TOC/WMATA Joint Fatigue Management Study for Metrorail on Nov. 17, 2011:
  - Absence of a formal hours of service program
  - Training available, but not utilized by employees
  - Data showed most work completed within 40-hour week, but significant outliers
  - Some overtime work adds to commuting time
  - Vacancies add to overtime demands
  - Secondary employment policy seems unenforceable





# Metro Bus Study

## Background

- Study conducted of Local 689 (ATU) and 922 (Teamsters) for all BUS (BTRA/BMNT) operators and mechanics
- WMATA has a safety mechanism built into BTRA scheduling software to track hours on-duty
- WMATA provides computer based training on the intranet

## Data Analysis

- Time Period: July 3-31, 2011
- Majority of BUS Transportation employees work approximately 8-12 hrs/day
- <1% of shifts were for work lasting over 16 hrs/day



# FRMS SAFTE-FAST Modeling Analysis Methodology

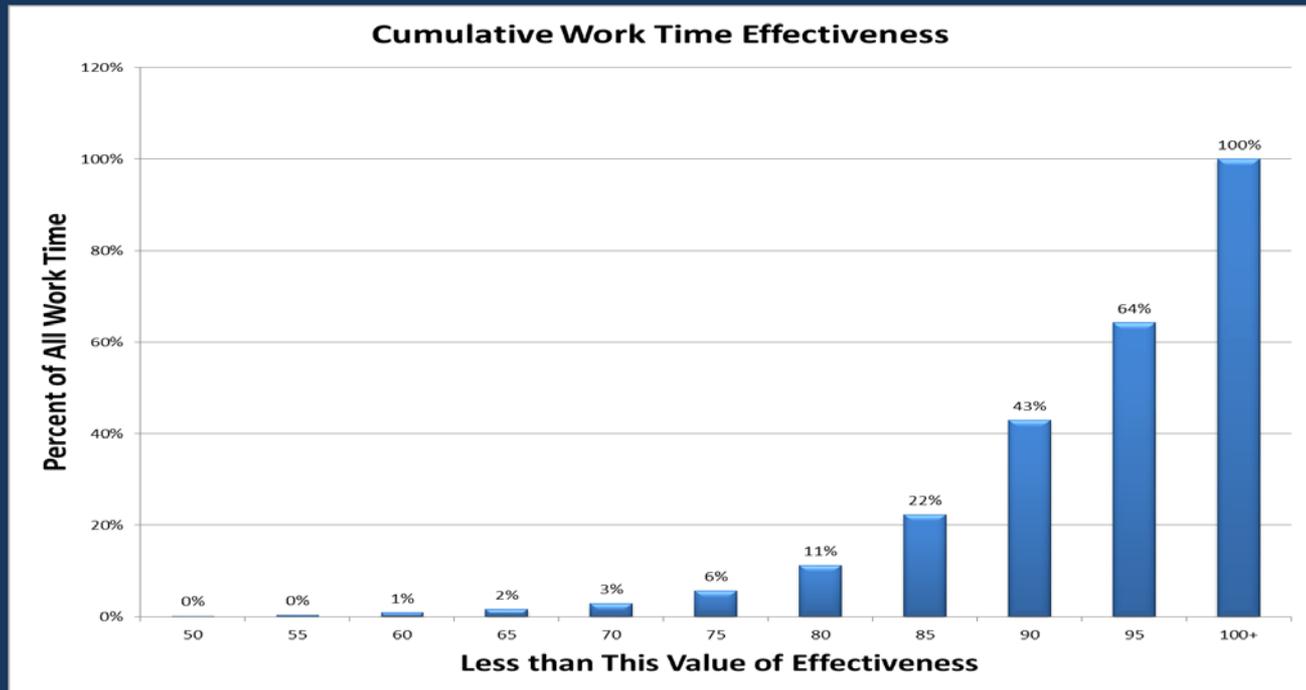
- Trapeze data for 537 rail operators and 2480 bus operators from April 2012 translated and processed through SAFTE-FAST
- Considered all work hours, both scheduled and overtime
- Fast Model Assumptions:
  - Bedtime: 2300
  - Max workday sleep: 8 hrs
  - Max rest day sleep: 8.5 hrs
  - No sleep zone: 1300-1900
  - Transition/Commute: 90 min
- Defined “Critical Hours” as Midnight to 0800
- Model eliminated naps during interim release





# FRMS SAFTE-FAST Modeling Analysis

## Profile of Effectiveness



### Rail Analysis:

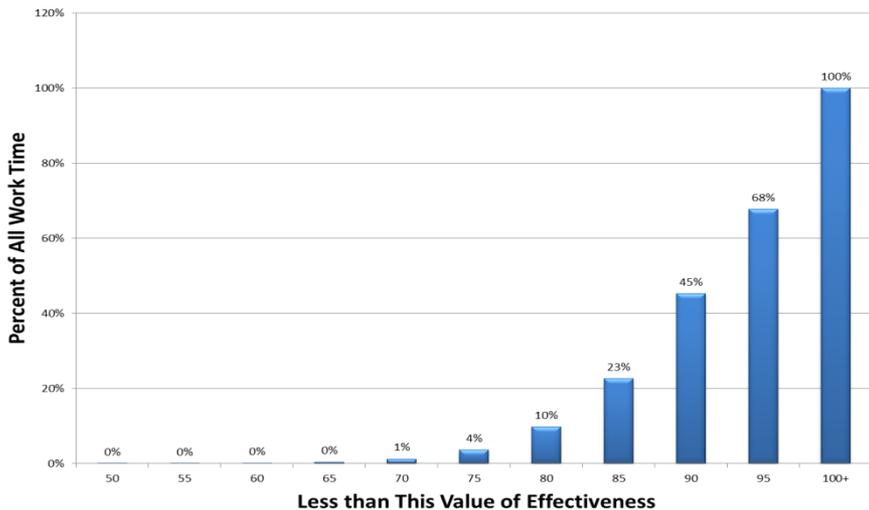
- 93% of operators' work hours do not create fatigue that exceeds the FRA criterion for mitigation – more than 20% of work time below 70 effectiveness
- Only 6-7% of operators exceed the criterion depending on sleep assumptions
  - Majority of sample group fatigue related to midnight shift workers with a large amount of work time (greater than 90hrs/month) between midnight and 0800 hours



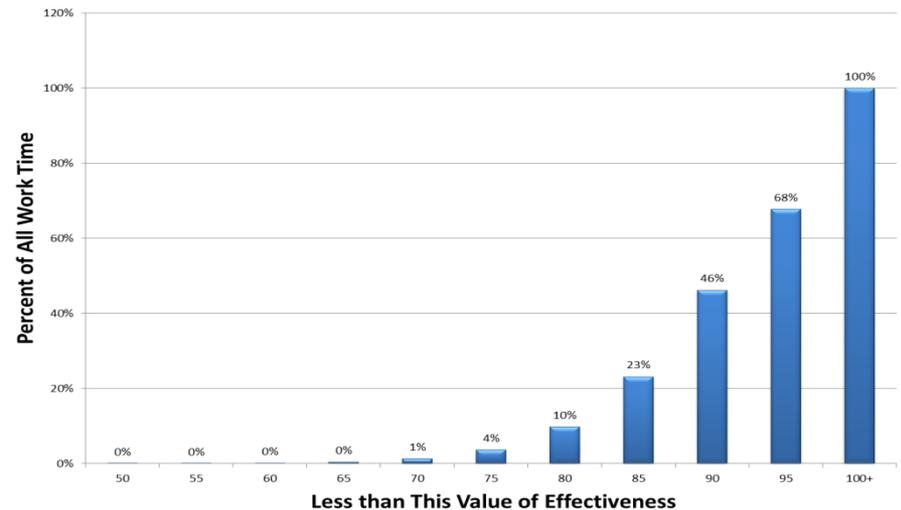
# FRMS FAST Modeling Analysis Bus Operators

## Profile of Effectiveness

Cumulative Work Time Effectiveness - Bus A Group



Cumulative Work Time by Effectiveness Level - Bus B Group



### Bus Analysis:

- Only 0.4% of bus operators' work hours create fatigue that exceeds the FRA criterion
- Majority of sample group fatigue is caused by early morning starts (0300 hours-0500 hours) and would be mitigated by advancing bedtime to 2200 hours



# FRMS FAST Modeling Analysis Conclusions

- **Rail operators**
  - 93% of operators' work hours do not create excessive fatigue that exceeds the FRA criterion
  - The major cause of this fatigue is the large amount of work time between midnight and 0800
  - Next step is to examine those schedules and mitigate the high night work hours
- **Bus operators**
  - 99.6% of bus operators' work hours do not create excessive fatigue that exceeds the FRA criterion
  - Majority of that fatigue is caused by early morning starts (0300-0500) and would be mitigated by advancing bedtime to 2200
  - Next step is to examine training to ensure that sleep habits mitigate fatigue risk
- **Work Hours per Month:** For these operators there was, at most, a very mild relationship between total work hours per month and fatigue
- **Hours of Service:** Is a component of fatigue management, but a more robust program will be needed to mitigate the issue of fatigue in employees



# FRMS Project

## Next Steps

- Conduct 2 week logbook Study
- Background Study
- Actigraph Study with subset

## Safety Critical Work Groups and Sample Sizes

Rail	Bus
Operators: (401/132)	Operators: (484/160)
ATC: (324/107)	Mechanics: (354/117)
On-Track equipment operators: (40)	



# Work Plan Elements and Schedule

