Truck-Tractor and Cargo Tank Semitrailer Rollover and Fire
Interstate Highway 69
Indianapolis, Indiana
October 22, 2009
Injuries

• Truck driver
  – Seriously injured

• Passenger vehicle occupants
  – 1 serious injury (Volvo driver)
  – 3 minor injuries
Parties to the Investigation

- Federal Highway Administration
- Indiana Department of Transportation
- Lawrence Township Fire Department
- Indiana State Police
- Mississippi Tank Company
- AmeriGas Propane
Safety Issues

- Driver fatigue management and rollover prevention programs
- Stability control systems and vehicle design
- Cross-slope breaks and protection of bridge pier columns
- Crashworthiness of Department of Transportation specification cargo tanks
Human Performance Factors
Driver Information

• Current license and endorsements
  – Cargo tank and hazardous materials
  – Corrective lens restriction
• 45 years driving trucks, 15 with cargo tanks
• Current medical card
• No evidence of drug/alcohol use
• No evidence of distractions
Consideration of Fatigue

- Driver could set work hours
- Uncertainty in sleep opportunity
- Uncertainty in sleep obtained
- Wide range of possibilities
- Insufficient information to determine fatigue
Fatigue Management Programs

- Displayed poor fatigue management
- Role of fatigue in rollovers
- Fatigue management programs
- AmeriGas practices
- Driver may be representative
Rollover Prevention Program

- Rollover is a problem
- “Vehicle Incident Prevention Program” not effective for rollovers
- Rollover awareness efforts
- Comprehensive rollover prevention program
- Australian program successful
Summary

• Cannot determine whether driver was fatigued

• Poor fatigue management by driver

• Rollover is a problem
Vehicle Factors
Rollover Prevention

Approaches

1. Stability control systems
   - Adding technology
   - Prevent excessive curve speed rollovers
   - Prevent loss of control from oversteer and understeer

2. Vehicle design
   - Lower and wider
   - Prevent all types of rollovers

Cargo tanks prone to rollover:
6% of fleet, 31% of fatal rollover accidents
Stability Control Systems

- Roll Stability Control (RSC)
  - Tractor or trailer based
- Electronic Stability Control (ESC)
  - Tractor based

Images courtesy of Bendix Commercial Vehicle Systems LLC
Stability Control Systems

- Market facts
  - Bendix, Meritor WABCO, Haldex
  - Available on all new tractors and trailers
  - Cost range $600 - $2,000
  - On the market for 10 years
  - 100,000 RSC and ESC units installed as of 2009 (ATRI)
  - 25% of tractors will have ESC by 2012 (NHTSA)
  - No current requirement for ESC on heavy vehicles
Stability Control Systems

• ESC required for passenger vehicles
  – Loss of control accidents reduction (NASS data)
    • 40% with cars, 70% with SUVs
  – NHTSA issued final rule in April 2007
    • All vehicles be equipped with ESC by model year 2012

• Benefits of RSC and ESC for heavy vehicles
  – 2009 NHTSA Study
    • RSC could prevent 3,489 crashes, 106 fatalities, and 4,384 injuries each year - $1.4 billion savings
    • ESC could prevent 4,659 crashes, 126 fatalities, and 5,909 injuries each year - $1.7 billion savings
Summary

• Previous NTSB recommendations on stability control standards (Dolan Springs)

• Stability control systems for ALL commercial vehicles
Vehicle Design

• Design considerations
  – Tank structural integrity
  – Ground clearance
  – Loading heights
  – Size and weight

• Roll Stability can be improved by
  – Lowering center of gravity height (CG)
  – Increasing track width
Vehicle Design

• Lowering CG
  – Fifth wheel height reduction
    • From 49 - 50 inches to 40 inches
  – Changing tank shape
    • Wider, elliptical, and drop-center
Vehicle Design

96” wide | 102” wide

Less than 30% in United States
More than 90% in Canada

12% accident reduction
17% accident reduction
Summary

• Performance-based standards
  – Design rollover resistant characteristics
  – Direct attention to vehicle design
Highway Factors
6 feet 12 feet 12 feet 8 feet

Left shoulder  Travel lanes  Right shoulder

+8% cross slope

10% cross-slope break

-2% cross slope
Cross-Slope Break

• AASHTO standards
  – 7 percent (1950s and 1960s)
  – 8 percent (current standard)
Cross-Slope Break Research

- Limited research conducted
- 1981 FHWA study
  - Simulation used a passenger car
  - Driver discomfort increased with shoulder slope
- No research found to address heavy trucks
Summary

• Best practices approach
• Knowledge gained at NTSB Public Hearing
• Options to assist state transportation agencies
W-Beam Guardrail

- Primarily designed to redirect passenger cars and pickup trucks
- Overall height – 30 inches
- Bridge columns located within clear zone
  - 14 feet from the edge of traveled way
  - 6 feet from the guardrail
Risk Assessment

- Existing bridges
- Higher standard of bridge column protection
- Documentation limited
- New construction represents small percentage of overall number of bridges
Indianapolis Connection Ramp

- Level of protection had not changed in 40 years
- Upgrading existing roadside barriers generally not high on list of priorities
- If new bridge, 42-inch-high concrete barrier would be required
Before and After Condition

**Before**
- 30-inch-high W-beam guardrail

**After**
- 45-inch-high concrete barrier
NTSB Safety Recommendations

• H-94-5, Evergreen, AL, 1993
  – Closed–Acceptable Alternate Action

• H-95-32 & 33, White Plains, NY, 1994
  – H-95-32, Closed–Acceptable Alternate Action
  – H-95-33, Closed–Acceptable Action
Attributes of Risk Assessment

• Two specific attributes
  – Redundancy and continuity
• Prevented I-465 overpass from collapsing
• Prioritize bridges in terms of vulnerability to collapse and damage
Summary

• FHWA position in the past
• Target the most unsafe locations
• Focused and strategic
• Proactive instead of reactive
Hazardous Materials
Factors
Hazardous Materials Release
Structural Integrity Requirements

• Stress to the cargo tank must account for
  – Maximum working pressure, plus
  – Liquid surge force of twice the weight of a full load

• Varying degrees of relevance to different tank types

• Federal regulations do not address external impacts to tank surfaces
Summary

• Cargo tank accident performance standards needed
• Analyze accident data to identify susceptible cargo tank structures
• Modeling and testing
• Develop improved design criteria
Trend Analyses

• Population of cargo tanks by DOT specification unknown

• Data must be normalized to conduct risk analyses

• DOT and industry studies based on uncertain cargo tank population estimates
Statistical Data
Summary

• Absence of distribution data for DOT-specification cargo tanks
• Limited ability to perform accurate trend analyses
• Insufficient information collected from motor carriers