Applied Vehicle Safety Research
Structures and Restraints Research Division

March 29, 2006

- Offset Frontal Research
- Hydrogen and Fuel Cell Safety Research
- Child Safety Research
NHTSA Frontal Offset Program

LTVs that perform better in offset tests seem to have stiffer front ends, thus aggravating compatibility.

This near-term program is focused on lower leg injuries in passenger cars.
Risk of AIS 2+ Injuries for Different Crash Modes

- **Body Region:** head, neck, chest, abdomen, spine, arms, legs
- **Risk of AIS 2+ Injury:**
  - full frontal
  - left offset
  - right offset
  - all frontal
Lower Extremity Injuries

- NHTSA estimates approximately 110,000 occupants sustain AIS 2 or 3 lower extremity injuries every year (75% of these are in cars).
- Annual Cost estimated at $9.2 billion.
- Lower Extremity Injuries
  - Knee-thigh-hip complex
    - 55% of AIS 2+ injuries
    - 42% Associated functional Life-years Lost to Injury
  - Remaining Lower extremities
    - 45% of AIS 2+ injuries (74% foot and ankle)
    - 58% Associated functional Life-years Lost to Injury
- FMVSS 208 designed to reduce fatalities and serious head, neck and torso injuries in frontal crashes, as well as a reduction in femur fractures.
Advanced Lower Leg (Thor-Lx/HIIIr) to Address Lower Leg Injuries

Axial Compliant Element

Accelerometers x,y

Triaxial Accelerometer

Upper Tibia Load Cell
Fx,Fz,Mx,My

Lower Tibia Load Cell
Fx,Fy,Fz,Mx,My

Ankle Rotation
(x,y,z)
Research Plan

• Investigate different seating procedures.
• Perform crash tests in stages (most vehicles receive top scores in IIHS tests – what will be the benefit of this rulemaking?)
  – Stage 1 – evaluate seating procedures and explore poor performers. Identify effective countermeasures.
  – Stage 2 – implement a fleet representative test matrix.
• Perform cost study of countermeasures.
• Thor-Lx federalization.
NHTSA’s Hydrogen, Fuel Cell, and Alternative Fuel Vehicle Safety Research Plan
Background

- **Why hydrogen?**
  - 2002 - FreedomCAR Program replaces PNGV
    Advance development of fuel cell vehicles (FCVs) and hydrogen fuel infrastructure
  - 2003 – FreedomCAR and Fuel Initiative
    Expands on FreedomCAR to make FCVs a viable choice by 2020
  - Reduce dependence on foreign oil, improve efficiency, reduce emissions
Vehicle Safety Research

Problem Definition

- What are the unique safety challenges presented by hydrogen and fuel cell vehicles?
  - Characteristics of hydrogen as an energy carrier differ from those of conventional vehicle fuels
  - Characteristics of hydrogen storage differ from storage of conventional fuels
  - Characteristics of fuel cells as high voltage electrical devices differ from batteries
  - Altered mass distribution may effect crashworthiness performance
## NHTSA’s Standards for Fuel System Integrity

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Path to FMVSS for Hydrogen and Fuel Cell Vehicles

- Conduct safety research in support of rulemaking objectives
- Promulgate equivalent 300 series FMVSS for hydrogen and fuel cell vehicles
- Facilitate International Harmonization through Development of Global Technical Regulations (GTR) in 2010 – 2012 timeframe
Supporting Research

- **Component level testing:**
  - Fuel container, powertrain, and delivery system safety performance testing

- **Full vehicle performance testing:**
  - Crash – front, side, rear
  - Electrical isolation of fuel cell, cooling system and auxiliary batteries
  - Post crash handling and EMS
  - CAFE testing
Research Projects

Where are we now?

- **FY 2006 ($1,256,000)**
  - Failure Modes and Effects Analysis of hydrogen fueled vehicles
  - Electrical isolation test procedure
  - High pressure cylinder testing
  - Comparative assessment of codes, standards and regulations
Child Safety Research
FMVSS No. 213 Update

- Published NPRM on Aug. 31, 2005 (Docket # 21245)
  - Extend standard to cover child restraints recommended for up to 80 pounds.
  - Federalize and test with HIII 10YO dummy.
  - Withdraw the weighted HIII 6YO dummy.
  - Keep FMVSS No. 213 injury criteria unchanged.

- Research efforts
  - Additional evaluation of child restraints rated for use 50 – 80lbs
    - Consider performance, booster seat mass, etc.
Child Safety - Side Impact

- Safety problem definition
  - Near-term focus is 3 year olds
  - Mid-term focus is 6 year olds
  - Identification of injury frequencies - fatalities as well as moderate and severe injuries
  - Identification of injury types (i.e., body regions and source of injuries)
    - CDS analyses
    - Clinical analyses with CIREN, SCI
Child Safety - Side Impact

Continued

• Test procedure development: Near-Term Q3s Dummy
  – Consider existing and new side impact procedures
    • Selection based on real-world injuries/outcomes

• Test procedure development: Mid-Term Q6s Dummy
  – Consider existing side impact countermeasures
    • Side airbag technologies (curtains, seat bags, etc.)
    • Vehicle interior components (door, sill, seatback, pillars, etc.)
Child Safety
Rear Seat Frontal Protection

• Effects of seatbelt, seat geometry, and belt fit for large children.
  – Consider real posture of large children
    • Vehicle seat – vary seatback, seat pad angle & height.
    • Belt geometries – vary lap and shoulder belt anchorages.
    • Static use evaluations.
  – Evaluate seat & belt fit dynamically – sled tests.
  – Propose optimal seat and belt geometries for larger children in rear seat.
Thank You