Upgrade of FMVSS No. 214 Enhancing Side Impact Protection

NHTSA Research & Development

March 2002

NPS Proposal

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- Draft an ANPRM in Summer 2002
- Conduct fleet tests for benefits assessment
- Use upgraded MDB
- Use current or new pole test procedure
- Develop test procedure for door opening evaluation
- Consider side airbag test procedures
- Evaluate / revise injury criteria
- Develop drawings & specifications for test devices
- Publish an NPRM
- Use appropriate dummies & instrumentation

NPS Rationale

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- High HIC failures in SINCAP
- U.S. fleet has changed since issuing FMVSS No. 214
- Current MDB no longer representative
- SID does not measure head acceleration or abdominal forces
- Petitions for side airbag rule and international harmonization

R & D Concerns

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- No time frame for the NPRM or final rule given
- Has not considered past agency decisions
- Has not considered the research of the last 3 years
- Several other items need to be considered in agency decision

Additional Considerations

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- **Chest deflection is considered by many as the most valid Injury Measure**
- **World-Wide standards use HIC, chest deflection, abdominal forces & pubic symphasis forces as criteria**
- **Test procedures & devices used in other jurisdictions are different**
  - Australia – European or US requirements
  - Japan – European requirements
  - Europe – European requirements
  - ES-1 dummy

Additional Considerations *(continued)*

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- **IIHS Proposed**
  - An MDB representative of SUV's
  - 5th percentile female SID II's Dummy
  - European test procedure, MDB shifted 12" rearward
- **NHTSA has 37 new cadaver data**
- **World SID may be available by 2010**
- **Preliminary injury criteria already developed**
- **Considerable amount of research test data available**
  - Load cell barrier data for IIHS barrier and Ford F-150
  - Pendulum & sled test data for ES-2 dummy
  - 23 crash test results – SID,ES-2 and FMVSS No. 214 & IIHS barriers
  - Dummies (front & rear)
  - Pole tests with SID H3, ES-2
  - NCAP type tests with ES-2, SID dummies

Analyses of the Safety Problem

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- Predominant problem is still with 50th percentile occupants followed by other sizes
- Head/neck, chest, abdomen & pelvis get injured
- Narrow objects and LTV's involved in large numbers
- Improved criteria needed for chest

Annual Estimate of Struck Side Occupants

(Non Rollover Towaway Side Crashes)
1991-2000 NASS Weighted Data / Occupant > = 140 CM in Height

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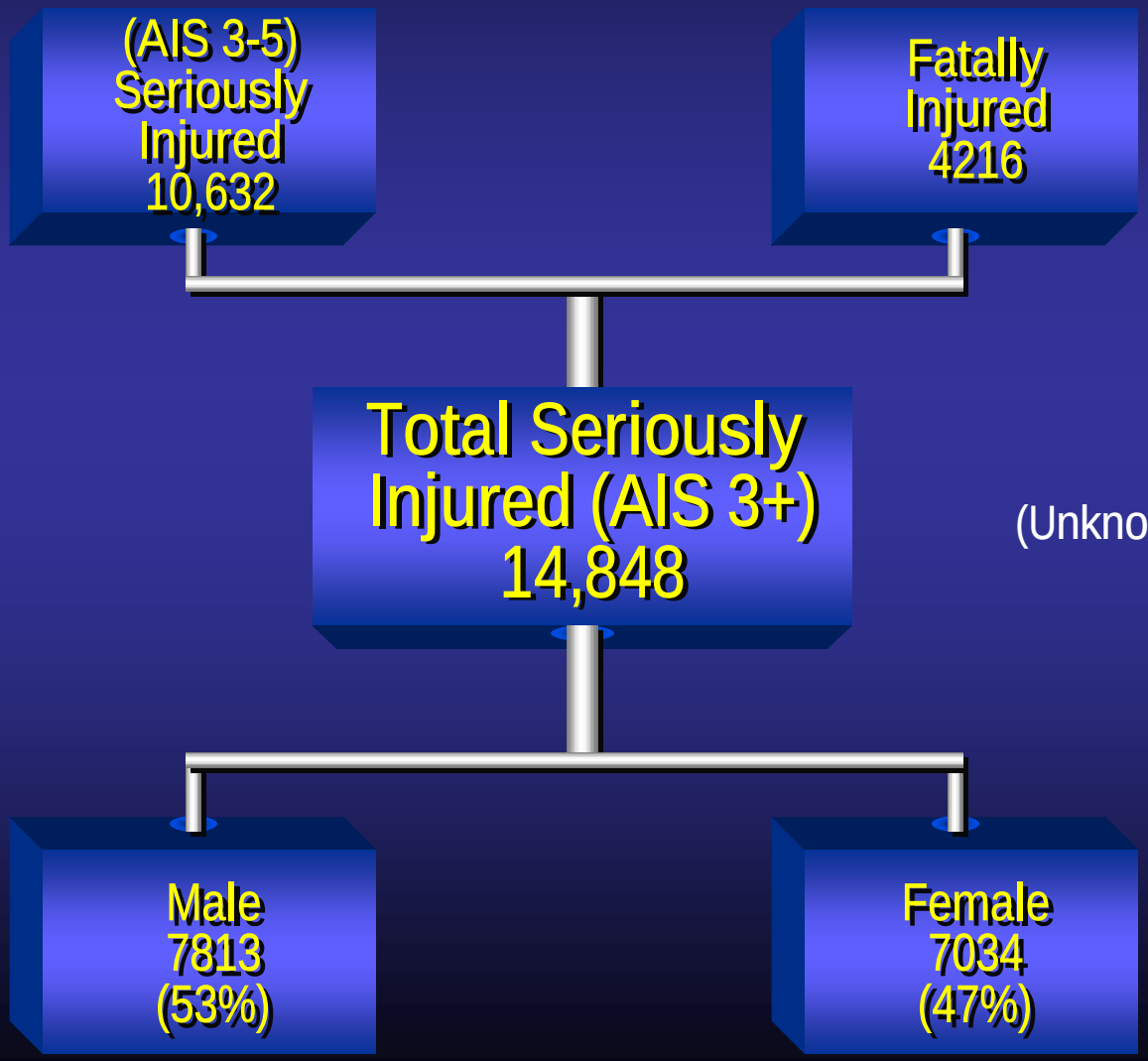

(Unknown less than .01%)

Annual Estimate of Struck Side Occupants

(Non Rollover Towaway Side Crashes)
1991-2000 NASS Weighted Data / Occupant <= 150 CM & 16+ years old

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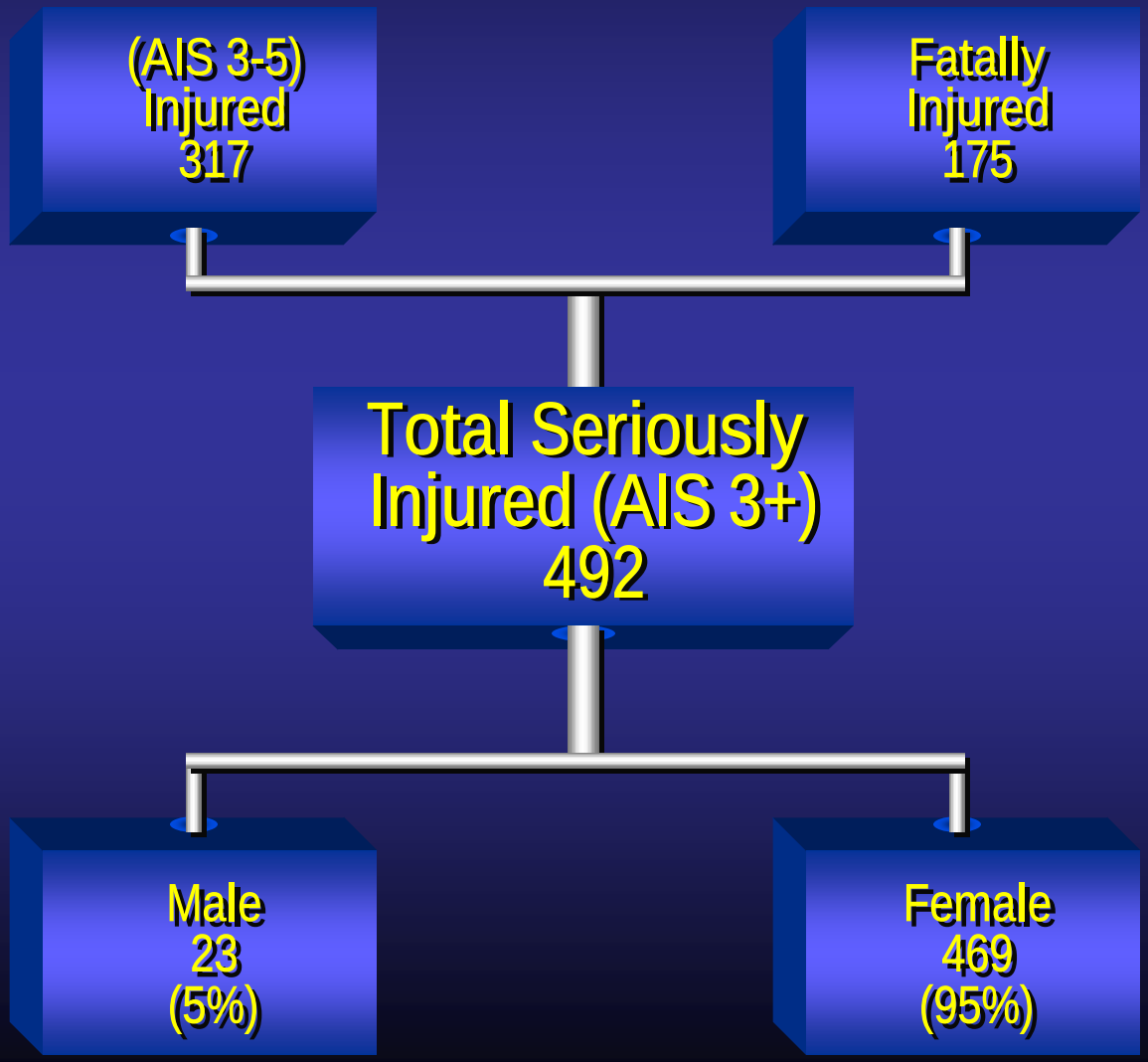

Annual Estimate of Struck Side Occupants

(Non Rollover Towaway Side Crashes)

1991-2000 NASS Weighted Data / Occupant > 140 CM

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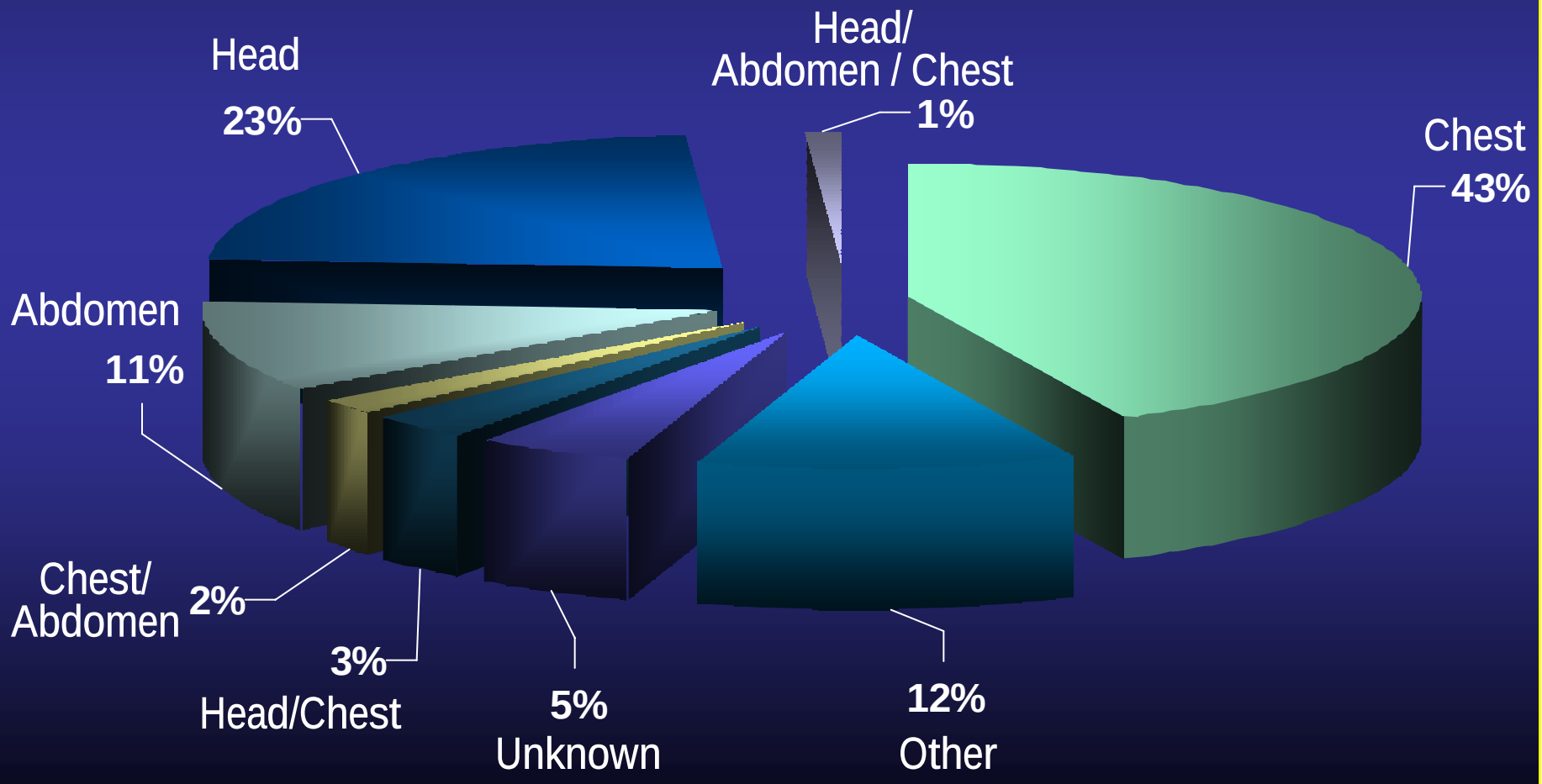
Distribution of Body Regions Injured Male Occupants



Current Safety Problem Fatalities

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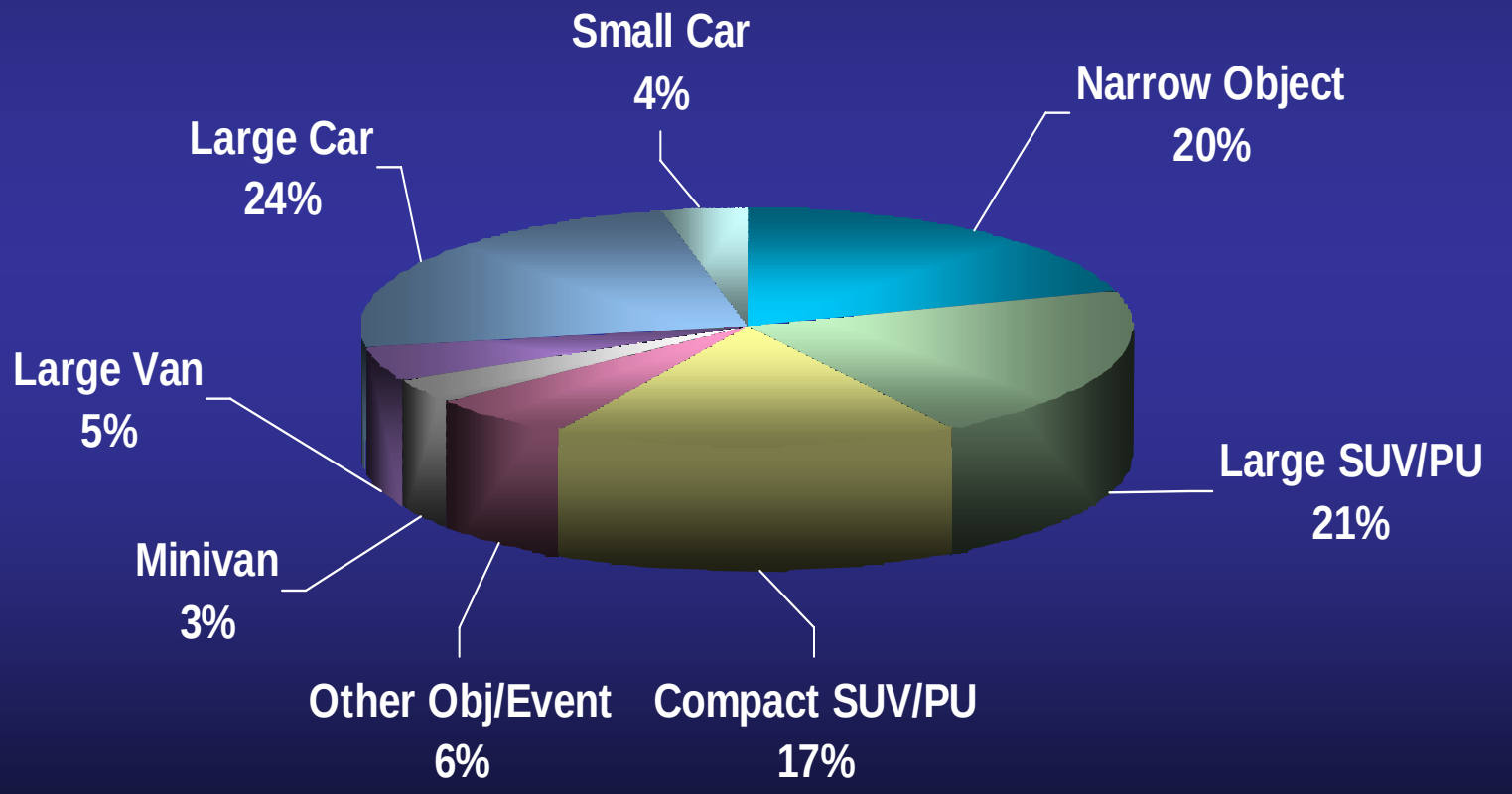
Near Side Belted Fatalities by Crash Partner



N~1,450 fatalities (total)/year

N~805 fatalities (belted)/year

1999 FARS Side Crashes – Model Year 1995+ (light vehicles ≤10,000lbs, no rollover)

Current Safety Problem Injuries

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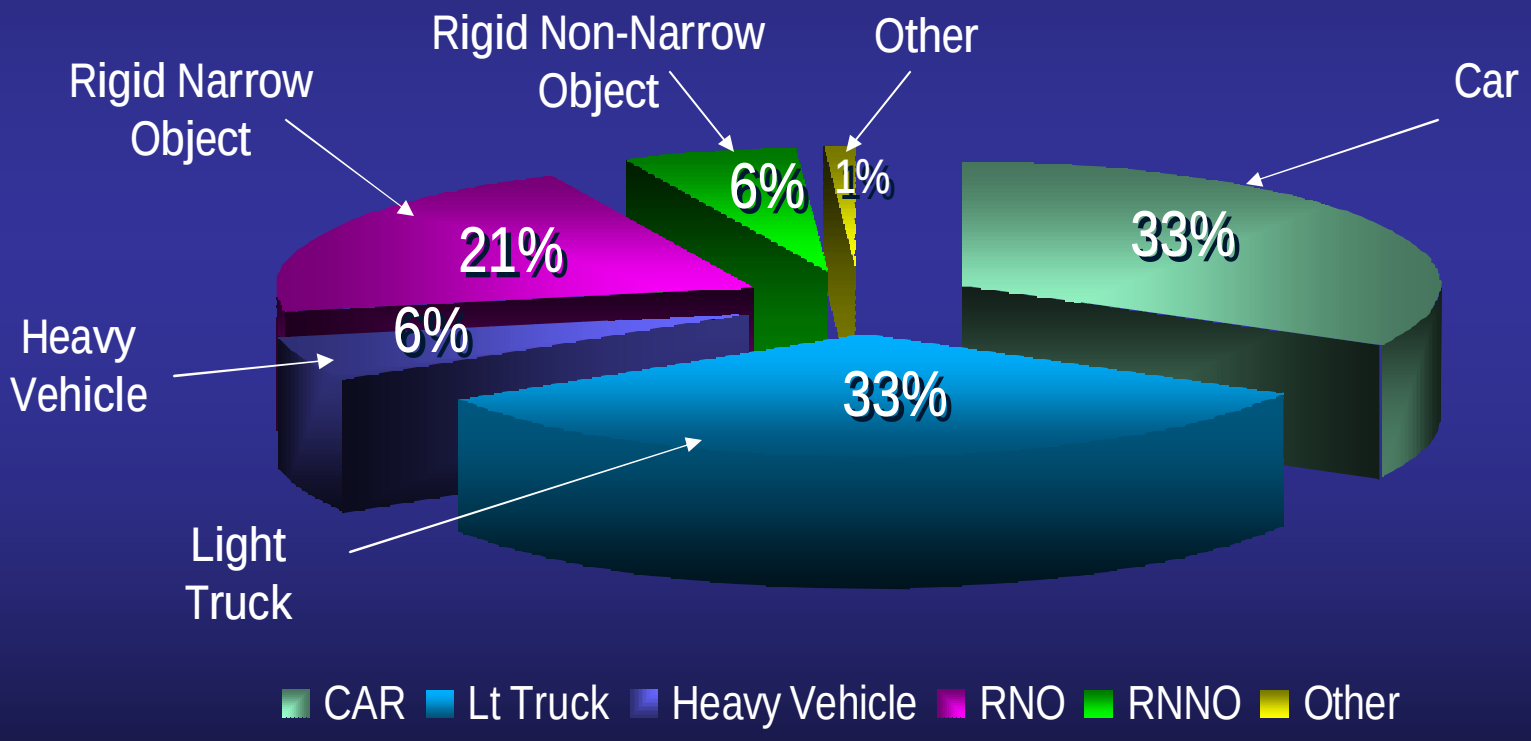
Occupants with AIS 3+ Injuries - Belted & Unbelted



3,272 Occupants (total)/year

NASS '95-'99 Weighted…Model Year 1995+ (light vehicles ≤10,000lbs, no rollover)

Current Safety Problem Injuries

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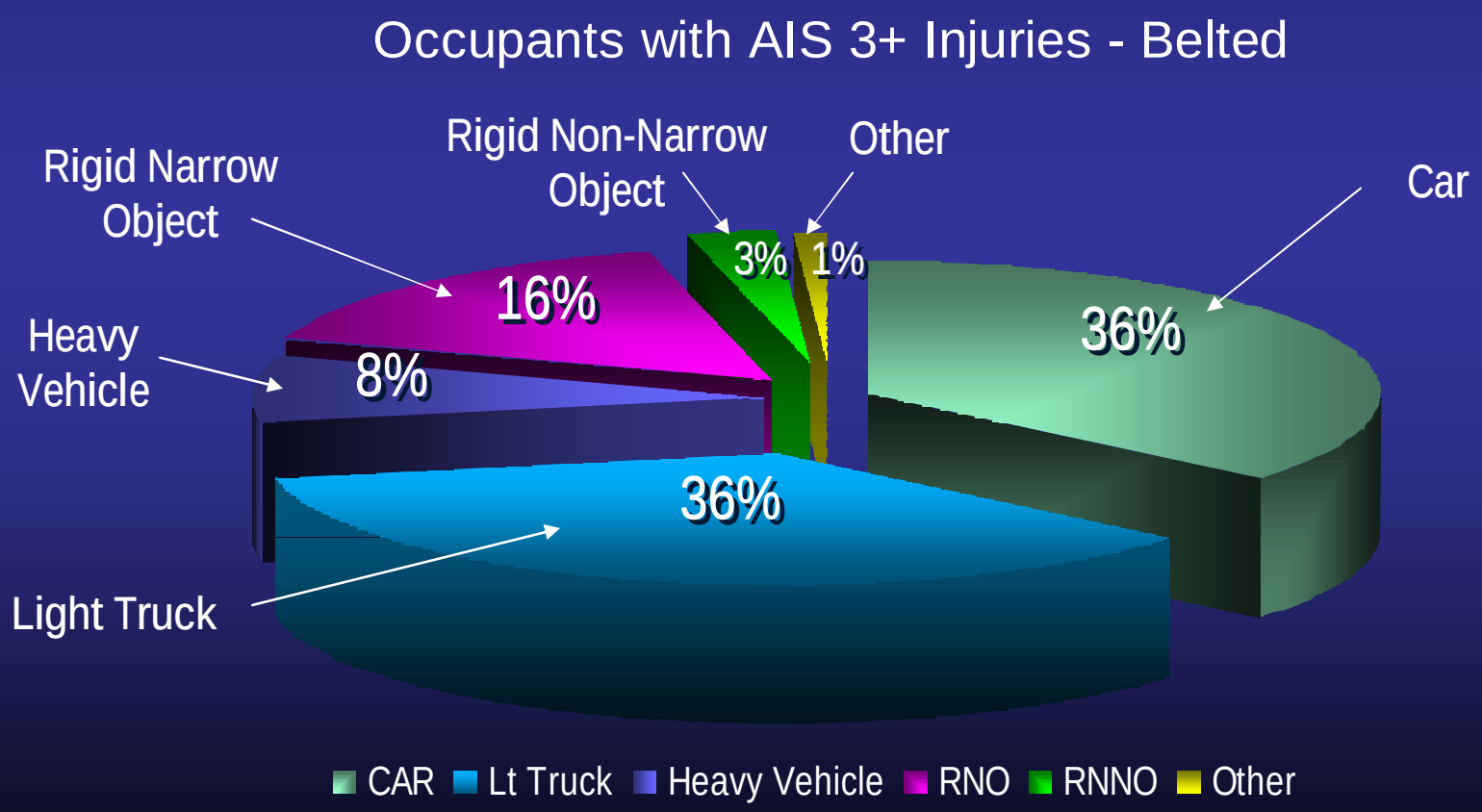
Near Side Belted Injuries by Crash Partner



NASS '95-'99 Weighted…

2,091 Occupants (belted)/year

COMPLETED: FMVSS 214 Matrix

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FMVSS 214 Upgrade - High Severity/Barrier Development Tests				
VEHICLE	BAG	IMPACTOR	DUMMY	TEST CONDITION
1999 Prizm	none	IIHS MDB/F150	ES-2	214 speed/angle
1999 Cadillac Deville	none	IIHS MDB/F150	ES-2	214 speed/angle
1999 Maxima	none	IIHS MDB	ES-2	214 speed/angle

FMVSS 214/Side NCAP- 2002 Fleet Performance Tests			
VEHICLE	SIZE/CLASS	BAG	DUMMY
2001 Focus	compact PC	none	SID*/ES-2
2002 Impala	medium PC	head/thorax combo	SID*/ES-2
2001 LeSabre	heavy PC	thorax	SID*/ES-2
2002 Escape	SUV	none	SID*/ES-2

*Tests run by NSA & NCAP

COMPLETED: FMVSS 201P Matrix, ES-2 Dummy Evaluation & Fleet Performance

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NOTE: This testing is also part of the side air bag effective study

201P – Side Impact Pole Tests		
VEHICLE	BAG	DUMMY
2001 Saturn	none	SIDH3/ES-2
2001 Saturn	curtain only	SIDH3/ES-2
1999 Maxima	none	SIDH3/ES-2
1999 Maxima	head/thorax combo	ES-2
1999 Volvo S80	curtain plus thorax	SIDH3*/ES-2
1999 Cougar	head/thorax combo	ES-2
2000 Saab	head/thorax combo	ES-2

*Test run by NSA

COMPLETED: LTV/Upgraded MDB to vehicle Test Matrix

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Test Vehicle	Seat Mounted SAB Configuration
2000 Audi A6	Curtain +Torso (SM)
1999 Chevrolet Prism	Torso (SM)
1999 Ford Windstar	Combo (SM)
1999 Mercury Cougar	Combo (SM)
2000 Nissan Maxima	Combo (SM)
1999 Saab 9-5	Combo (SM)
1999 Toyota Camry	Torso (SM)
1999 Volvo S80	Curtain +Torso (SM)
1999 VW Jetta	Torso (SM)
2001 Saturn	Curtain + Torso(SM)

SM = Seat Mounted
DM = Door Mounted
Combo= Head & Torso

COMPLETED: LTV/Upgraded MDB to vehicle Test Matrix (continued)

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Test Vehicle	Door Mounted SAB
2000 BMW 5	Head Tube +Torso (DM)
1999 Cadillac Deville	Torso (DM)
2000 Mercedes S-Series	Curtain +Torso (DM)

SM = Seat Mounted
DM = Door Mounted
Combo= Head & Torso

Completed VTV Test Matrix: Pole test Vehicles Highlighted

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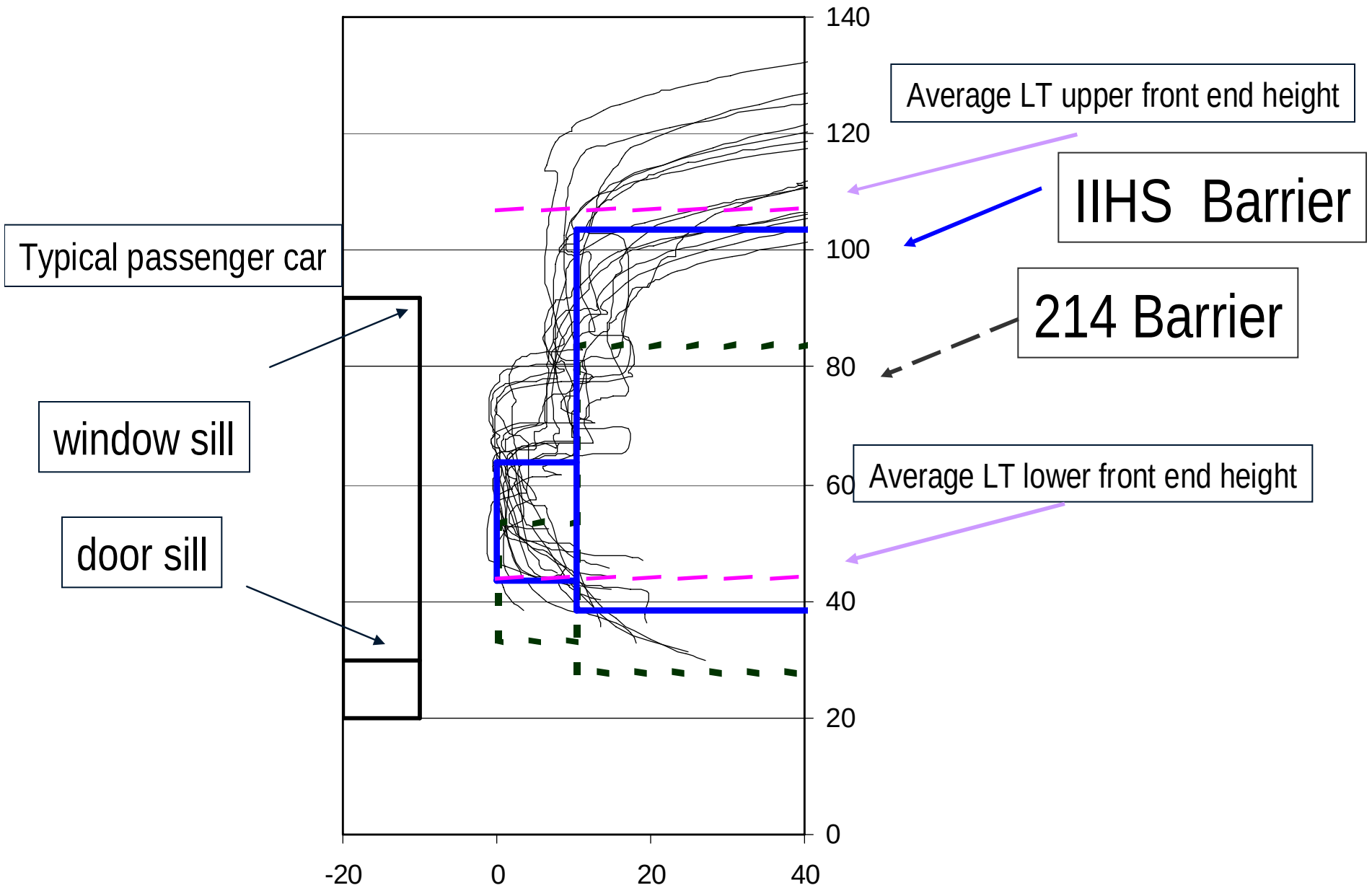
Test Vehicle	SAB Configuration
2000 Audi A6	Curtain + Torso (SM)
2000 BMW 5	Head Tube+Torso (DM)
1999 Cadillac Deville	Torso (DM)
1999 Chevrolet Prism	Torso (SM)
1999 Ford Windstar	Combo (SM)
1999 Mercury Cougar	Combo (SM)
2000 Mercedes S-Series	Curtain + Torso (DM)
2000 Nissan Maxima	Combo (SM)
1999 Saab 9-5	Combo (SM)
1999 Toyota Camry	Torso (SM)
1999 Volvo S80	Curtain+Torso (SM)
1999 VW Jetta	Torso (SM)

SM = Seat Mounted
DM = Door Mounted
Combo= Head & Torso


Typical passenger car
window sill
door sill
Average LT upper front end height
IIHS Barrier
214 Barrier
Average LT lower front end height
140
120
100
80
60
40
20
0
-20
0
20
40

IIHS MDB

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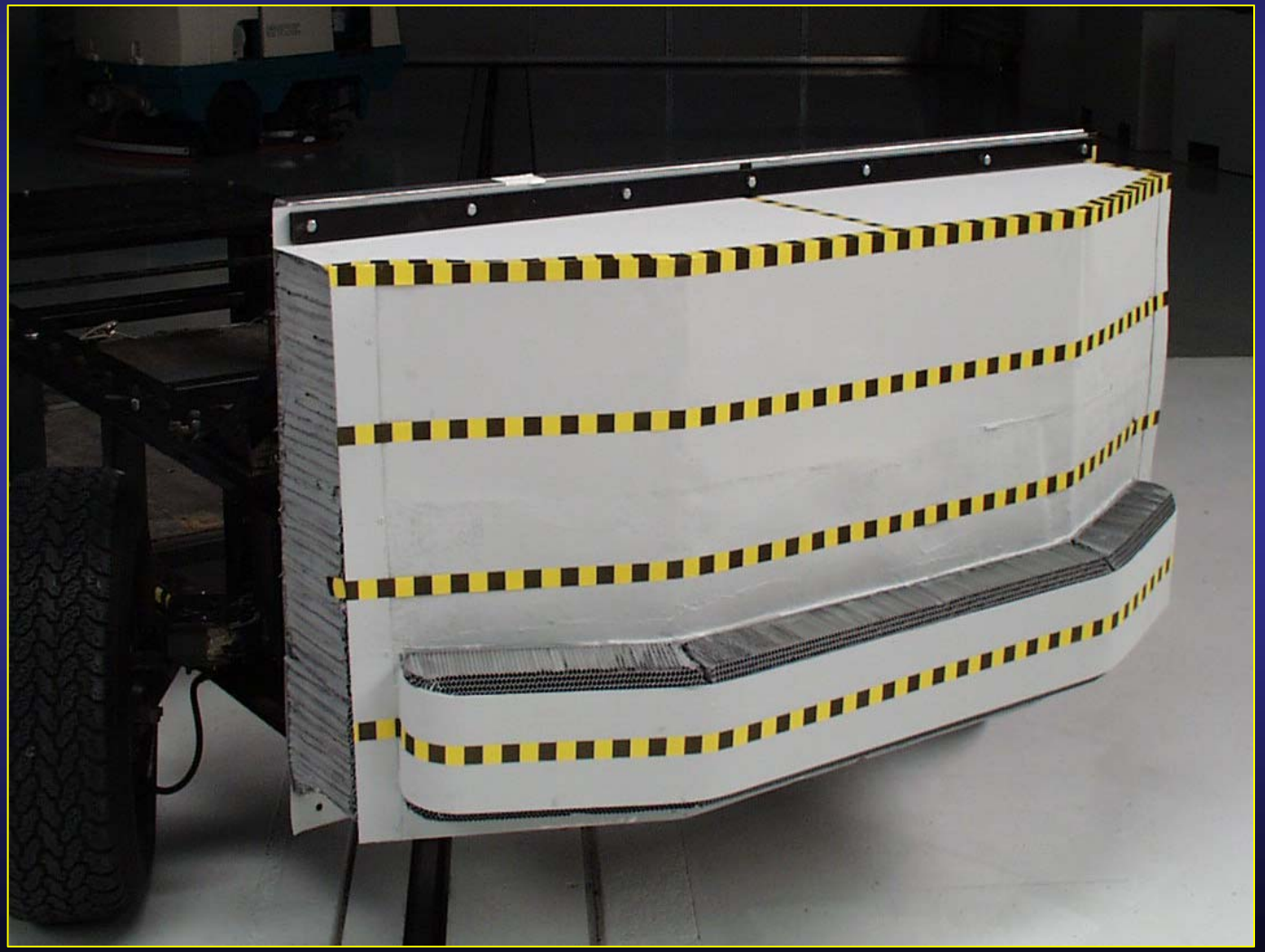

Concerns About the IIHS Plans

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- The Barrier Design & Procedure May not Test All vehicles Consistently
- With SID IIs, IIHS Main Interest is to Show Head Strikes
- Dummy Durability, Repeatability and Injury Criteria Have Not been Shown
- Does Not Address the Biggest Safety Problem - the 50th Percentile
- Without Sill Engagement, Changes May Lead to Undesirable Vehicle Designs
- Will Eliminate Fuel Efficient Vehicles from the Fleet
- Rear Dummy Results May not Be Repeatable
- Could Result in Less Protection in Rear
- Will Promote Aggressive inflatable Curtains and Side Air Bags

Agency Options

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Option 1

- Issue ANPRM as Proposed
- Develop Barrier Representative of Current Fleet
- Add the Current 201 type Pole Test
- Develop Injury Criteria for 5th percentile Occupant
- Conduct Crash Tests for Benefit Analysis using the 50th & 5th Percentile

Option 1 A

- The same as above Using Current Barrier

Pros and Cons of Option 1

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Pros

- Feasible to issue ANPRM by Summer
- Could be Perceived as Addressing Head Protection Needs before IIHS
- Industry May not Oppose

Cons

- May not Result in Near-Term Benefits
- Will Require Substantial Research & Testing
- Earliest Implementation will be After 2007
- Would be interpreted as Delaying Tactics by Some

Option 1 A May be a little sooner than Option 1

Agency Options (Continued)

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Option 2

- Issue an NPRM by Fall 2002
- Use Modified 214 Barrier (Increased weight and Height)
- Use SIDH3 Dummy
- Conduct Research as Necessary for Federalizing SID IIs
- Develop Injury Criteria for Above
- Conduct Additional Crash Tests for Benefit Analysis using 50^{th} & 5^{th} Percentile

Option 2 A

- Could go with the Above without the Modified Barrier

Pros and Cons

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Pros

- Final Rule May be implemented by 2005
- Less Research needed compared to Option 1
- Manufacturers may not Oppose

Cons

- Benefits will be minimal – Chest & Abdomen and Pelvis will not be Improved
- The Last 10 Years' Criticisms of SID and Injury Criteria Will Remain
- Modified Pole Test for Loading Chest & Head Will be Necessary
- Latest R&D Analysis Concluded SID is slightly less Biofidelic than ES-2
- Need to Establish SID II s Durability, Repeatability, Injury Criteria & Benefits
- Will Need Research to Address NPRM Comments
- Will Require Crash Tests for Benefit Estimates
- Will be Perceived as Moving Away From Harmonization

Option 3

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- Issue an NPRM by Fall 2002
- Use Modified 214 Barrier
- Use Modified Pole Test to Load Chest and Head
- Use ES-2 Dummy for 50th
- Conduct Necessary Research to Include SID IIs as additional dummy

Options A

- Could Propose the Above without the Modified Barrier

Pros & Cons of Option 3

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Pros

- May be able to Implement Final Rule in the shortest time
- Very little Additional Research Needed for the 50th percentile
- Will Address All Body Regions Being Injured
- Will Result in Substantially More Benefits
- Previous Criticisms of SID & Injury Criteria May Be No Longer an Issue
- All the necessary Crash Tests for the 50th percentile have been completed
- ES-2 Dummy has been Found to Be Durable & Slightly Better in Biofidelity
- The Only Dummy Available Currently for Harmonization

Cons

- Back Plate Loading Is an Issue in Some Vehicles which needs to be solved
  - Can Be Addressed by Setting Limits on Loads Through the Plate
  - Alternatively, Use a Shield in testing to prevent Load Transfer (Research Already Initiated that will be completed by July)
- Manufacturers May Oppose Because of Increased Stringency (*Please add Bullet Symbol)*

R&D Recommendations

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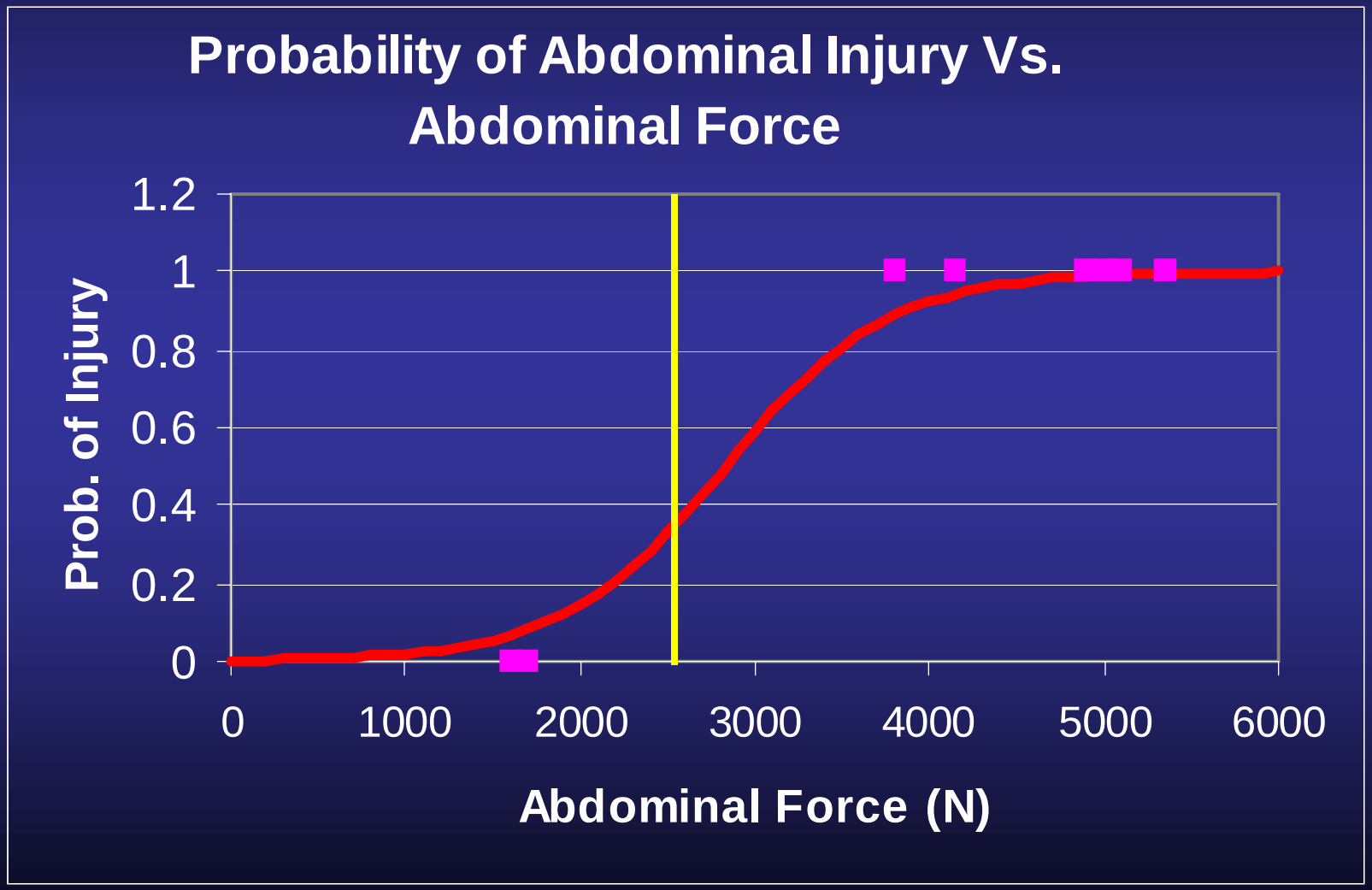
- Put an NPRM out and not ANPRM
- Use the Research Findings Available Today
- Select Option(s) most likely to give maximum Benefits
- Derive the Benefits Available As Early As Possible
- Consider the World SID (if Proven) using Properly Designed MDB for Future Upgrade Beyond 2010



Abdominal Force Limit = 2500 N