

SAE SYMPOSIUM
Highway Vehicle Event Data Recorder

***The Use of EDR Technology to Support
NHTSA's Crash Investigation Programs***



John Hinch
Augustus "Chip" Chidester
John Brophy
Thomas Roston



Special thanks to Eric Ferguson for data analysis

June 2004

Top 10 Leading Causes of Death in the United States for 2001, by Age Group



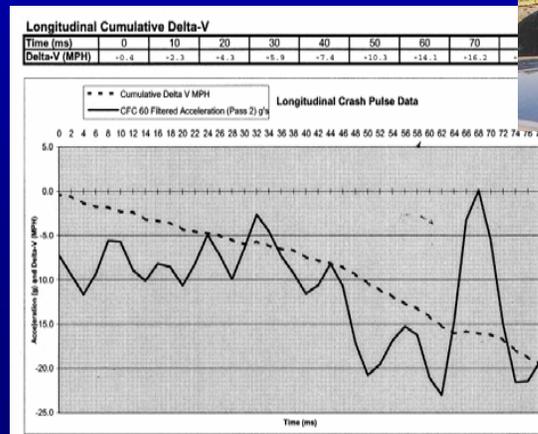
RANK	Cause and Number of Deaths											Years of Life Lost
	Infants Under 1	Toddlers 1-3	Young Children 4-7	Children 8-15	Youth 16-20	Young Adults 21-24	Other Adults			Elderly 65+	All Ages	
							25-34	35-44	45-64			
1	Perinatal Period 13,734	Congenital Anomalies 496	MV Traffic Crashes 533	MV Traffic Crashes 1,546	MV Traffic Crashes 5,979	MV Traffic Crashes 4,136	MV Traffic Crashes 6,759	Malignant Neoplasms 16,569	Malignant Neoplasms 139,785	Heart Disease 582,730	Heart Disease 700,142	Malignant Neoplasms 23% (8,614,131)
2	Congenital Anomalies 5,513	MV Traffic Crashes 421	Malignant Neoplasms 400	Malignant Neoplasms 829	Homicide 2,414	Homicide 2,738	Homicide 5,204	Heart Disease 13,326	Heart Disease 98,885	Malignant Neoplasms 390,214	Malignant Neoplasms 553,768	Heart Disease 22% (8,110,571)
3	Heart Disease 479	Accidental Drowning 393	Exposure to Smoke/Fire 178	Suicide 447	Suicide 1,879	Suicide 1,924	Suicide 5,070	MV Traffic Crashes 6,891	Stroke 15,518	Stroke 144,486	Stroke 163,538	MV Traffic Crashes 5% (1,700,952)
4	Homicide 332	Homicide 362	Congenital Anomalies 168	Homicide 391	Malignant Neoplasms 814	Accidental Poisoning 771	Malignant Neoplasms 3,994	Suicide 6,635	Diabetes 14,913	Chronic Lwr. Resp. Dis. 106,904	Chronic Lwr. Resp. Dis. 123,013	Stroke 5% (1,687,683)
5	Septicemia 312	Malignant Neoplasms 321	Accidental Drowning 164	Congenital Anomalies 324	Accidental Poisoning 566	Malignant Neoplasms 768	Heart Disease 3,160	HIV 5,867	Chronic Lwr. Resp. Dis. 14,490	Influenza/Pneumonia 55,518	Diabetes 71,372	Chronic Lwr. Resp. Dis. 4% (1,444,745)
6	Influenza/Pneumonia 299	Heart Disease 200	Homicide 133	Accidental Drowning 293	Heart Disease 398	Heart Disease 543	Accidental Poisoning 2,507	Accidental Poisoning 5,036	Chronic Liver Disease 13,009	Diabetes 53,707	Influenza/Pneumonia 62,034	Suicide 3% (1,079,822)
7	MV Traffic Crashes 139	Exposure to Smoke/Fire 170	Heart Disease 82	Heart Disease 273	Accidental Drowning 326	Accidental Drowning 211	HIV 2,101	Homicide 4,268	Suicide 9,259	Alzheimer's 53,245	Alzheimer's 53,852	Perinatal Period 3% (1,070,154)
8	Nephritis/Nephrosis 133	Septicemia 96	MV NonTraffic Crashes 51	Exposure to Smoke/Fire 140	Congenital Anomalies 244	Congenital Anomalies 206	Stroke 601	Chronic Liver Disease 3,336	MV Traffic Crashes 8,750	Nephritis/Nephrosis 33,121	MV Traffic Crashes 42,443	Diabetes 3% (1,014,201)
9	Stroke 108	Influenza/Pneumonia 92	Benign Neoplasms 46	MV NonTraffic Crashes 125	Accidental Falls 114	HIV 167	Diabetes 595	Stroke 2,491	HIV 5,437	Septicemia 25,418	Nephritis/Nephrosis 39,480	Homicide 3% (924,263)
10	Meningitis 78	Perinatal Period 63	Septicemia 33	Chr. Lwr. Resp. Dis. 102	Acc. Dischg. of Firearms 114	Accidental Falls 134	Congenital Anomalies 458	Diabetes 1,958	Nephritis/Nephrosis 5,106	Hypertension Renal Dis. 16,397	Septicemia 32,238	Chronic Liver Disease 2% (623,998)
ALL	27,568	4,288	2,703	6,672	15,851	14,940	41,683	91,674	412,204	1,798,420	2,416,425	All Causes 100% (36,866,317)

Discussion Topics

Government/Research



- EDR field data collection program at NHTSA
 - Collection rates & missing data issues
- What we have learned
- Sample case
- The bottom line



EDR Field Data Collection Program at NHTSA



- Data collected to Electronic Data System (EDS)
- Data collection systems
 - NASS-CDS
 - SCI
 - CIREN

• First case in 1991
• ~2,000 cases to date



EDR Field Data Collection Program at NHTSA

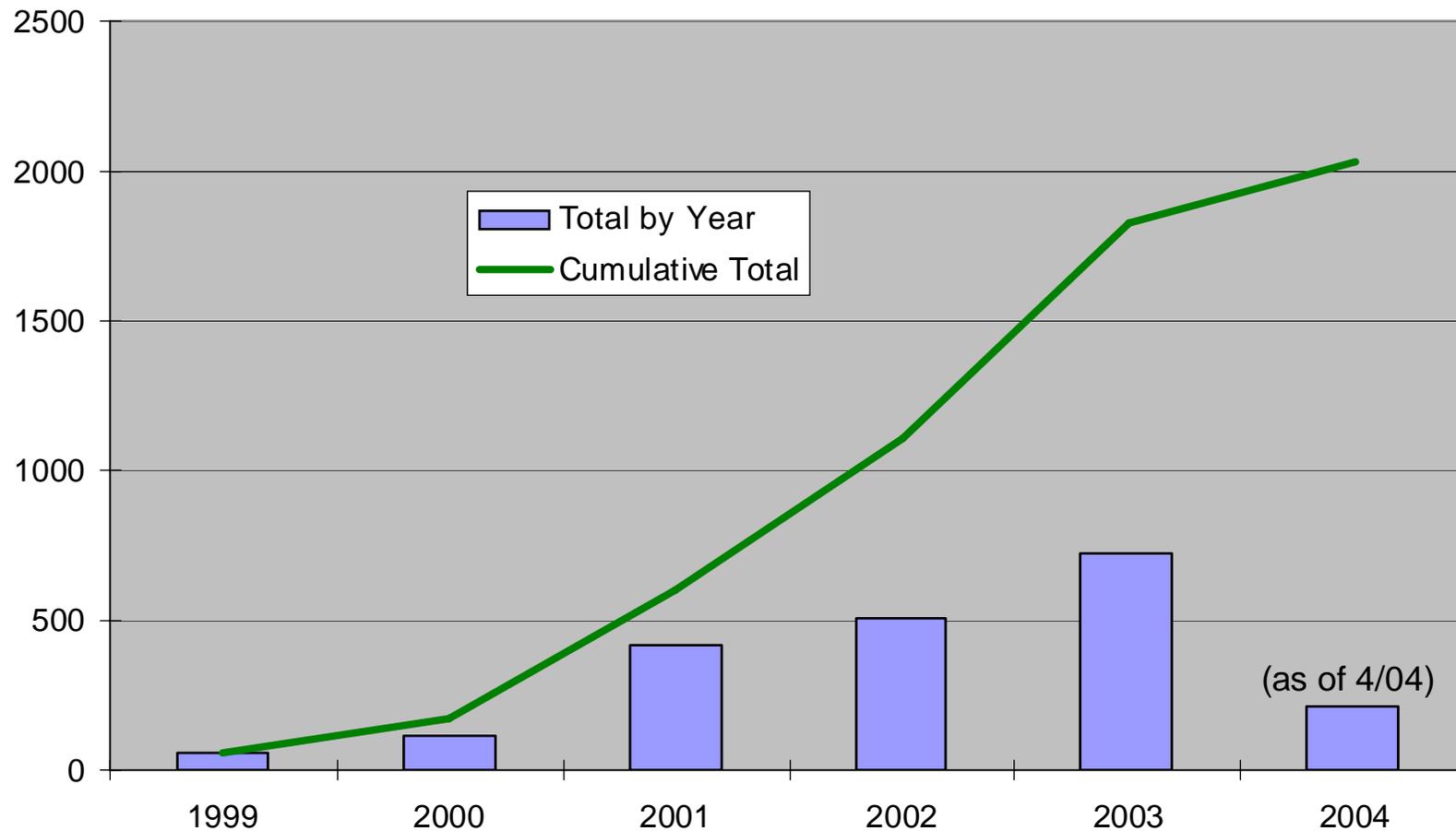


- CY2002 first data collection year that EDR data has coded variables in NCSA EDS.
- CY2002 all NASS/SCI/CIREN team members were equipped with Vetronix CDR units.

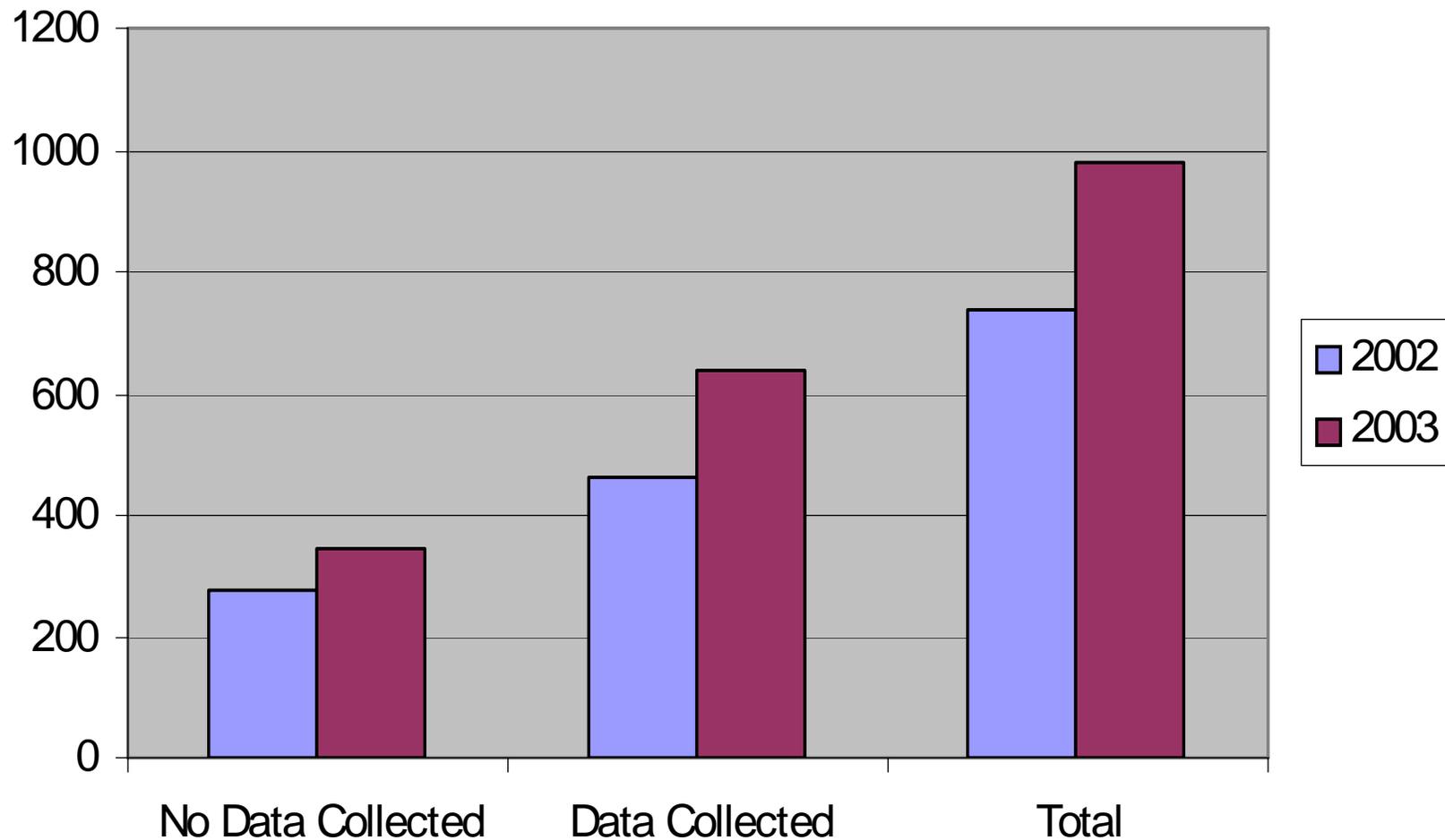
EDR Field Data Collection Progress (all programs)



EDR downloads from NASS, SCI, & CIREN



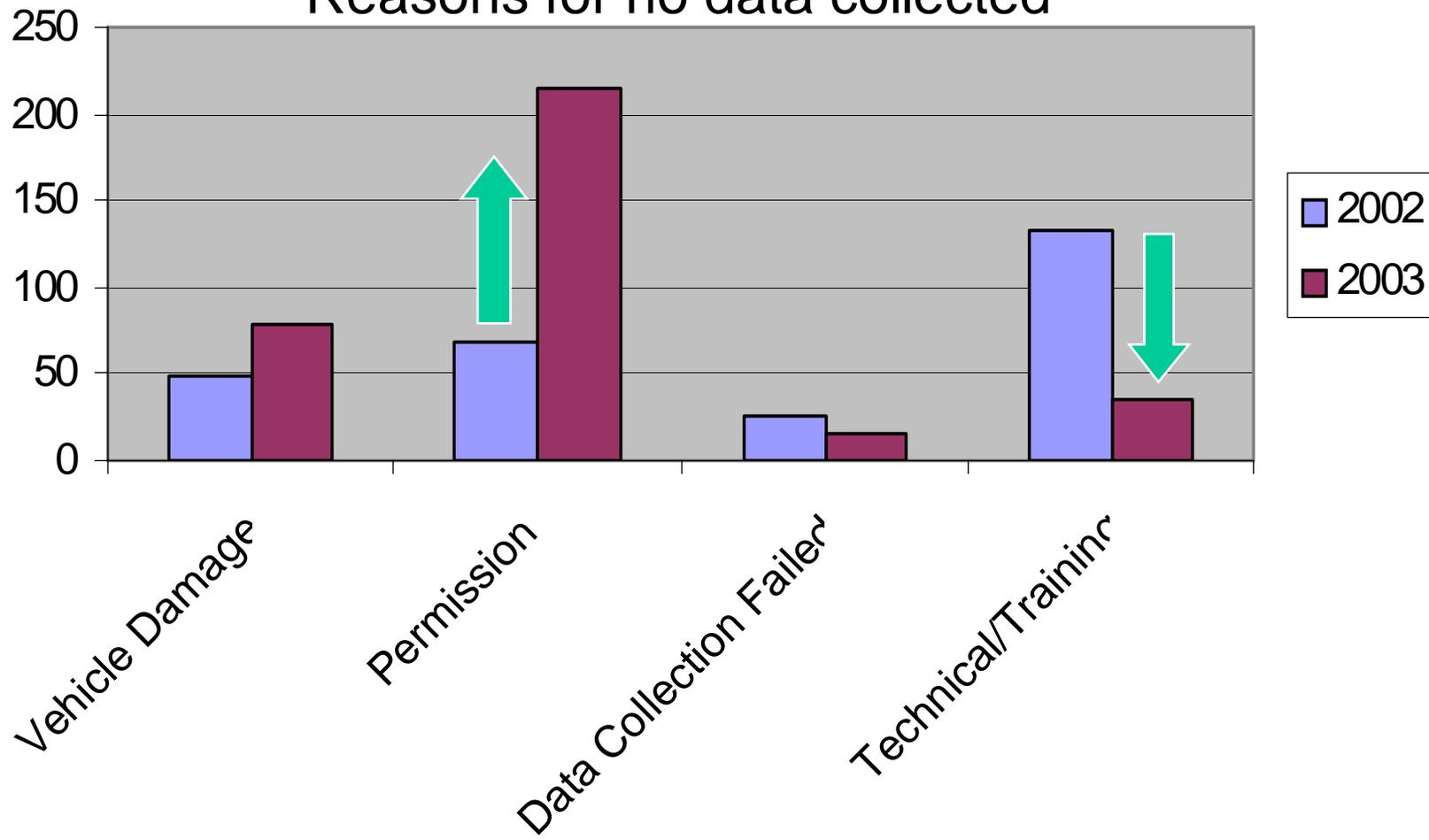
EDR Field Data Collection Program at NHTSA, NASS



EDR Field Data Collection Program at NHTSA, NASS



Reasons for no data collected



CY2002 NASS CDS Oracle to SAS Data Set



- 11 tables in current SAS
- 26 tables in Oracle to SAS set
 - Far more data available for detailed analysis
- CY 2002 weighted Oracle to SAS file is scheduled for release in May 04

New EDR Variables in CY2002



-
- The data set has expanded to allow event data to be stored
 - Since EDR output varies by manufacturers, a common variable set was developed based on the current output

What We Have Learned: EDR Data Collection



- The most effective method to observe and/or measure and confirm the performance of Advanced 208 Compliant Occupant Protection System Features is through the EDR data
 - Crash pulse, time to deployment, restraint usage, etc
 - Deployment timing of the dual-stage air bag system



Sample EDR Data Collected in a Multi-Stage AB System



1GCEC19TX3Zxxxxxx System		ent
SIR Warning Lamp Status		
Driver's Belt Switch Circuit Status		
Ignition Cycles At Deployment		
Ignition Cycles At Investigation		375
Maximum SDM Recorded Velocity Change (MPH)		-8.93
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)		117.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)		35
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)		N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)		0
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)		N/A
Time Between Near Deployment And Deployment Events (sec)		N/A
Frontal Deployment Level Event Counter		1
Event Recording Complete		Yes
Multiple Events Associated With This Record		No
One Or More Associated Events Not Recorded		No

Air Bag Operation Data

Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec) 35

Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec) N/A

Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec) 0

Sample EDR Data Collected in a Multi-Stage AB System



EDR Control Module Data

Data Validity Check:	Valid	EDR Model Version:	141
Time From Side Safing Decision to Left (Driver) Side Bag Deployment:	21		
Time From Side Safing Decision to Right (Passenger) Side Bag Deployment:	Not Deployed		
Passenger Airbag Switch Position During Event:	N/A		
Diagnostic Codes Active When Event Occurred:	0		

Algorithm Times

Actual initiation depends on restraint system status (below).

	ms
Time From Algorithm Wakeup to Pretensioner:	14
Time From Algorithm Wakeup to First Stage - Unbelted:	17
Time From Algorithm Wakeup to First Stage - Belted:	21
Time From Algorithm Wakeup to Second Stage:	0

Restraint System Status

Driver Seat Belt Buckle:	Engaged
Passenger Seat Belt Buckle:	Not Engaged
Driver Seat Track In Forward Position:	No
Passenger Seat Weight Switch Position:	N/A

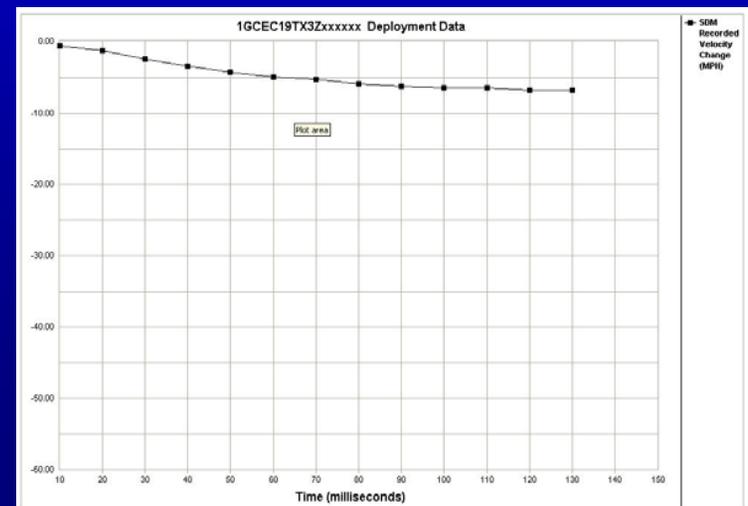
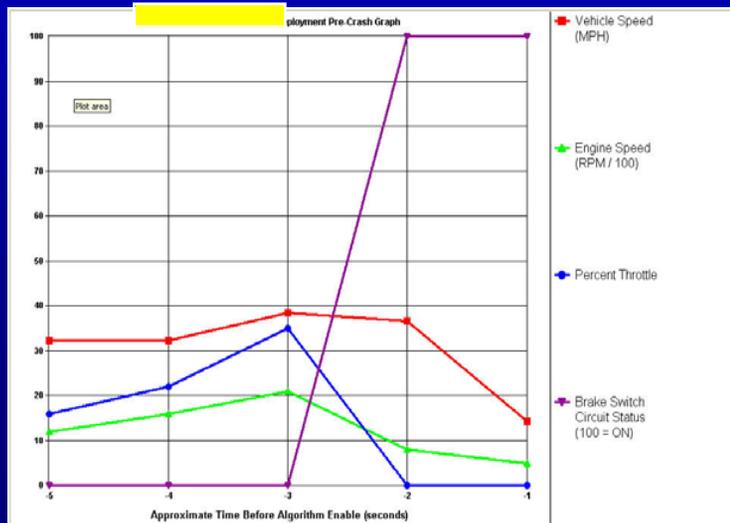
Deployment Initiation Attempt Times

	Driver	Passenger
Time From Algorithm Wakeup to Pretensioner Deployment Attempt:	14	Unbelted
Time From Algorithm Wakeup to First Stage Deployment Attempt:	21	21
Time From Algorithm Wakeup to Second Stage Deployment Attempt:	Disposal	Disposal

What We Have Learned: EDR Data Collection



- We can only read a limited number of vehicles
 - Vetronix CDR tool
 - Version 2.2.4 of Vetronix Software
 - Most General Motors 1994 and newer
 - Some Ford and Mercury 2001 and newer
 - Isuzu Hombre 2000 - 2002 and Ascender 2003



Sample Case



■ Case vehicle

- 2003 Chevrolet K1500 Silverado ext cab pickup
- Occupant
 - Driver only
- Injury severity
 - Minor injury (AIS-1 -abrasions to his left forearm)

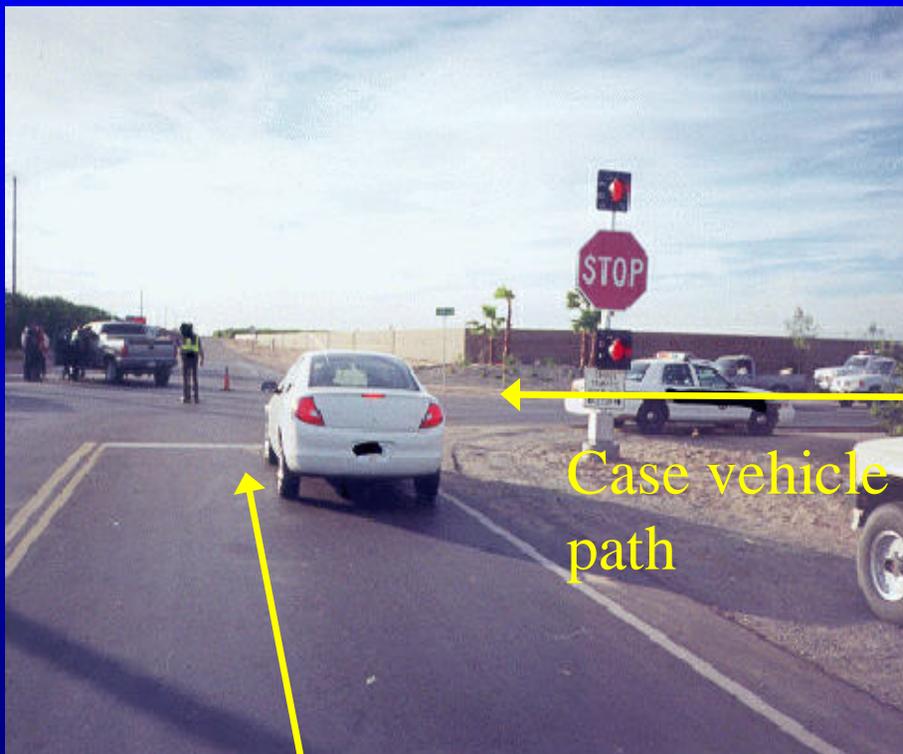
■ Other vehicle

- 1997 Honda Accord

■ Crash configuration

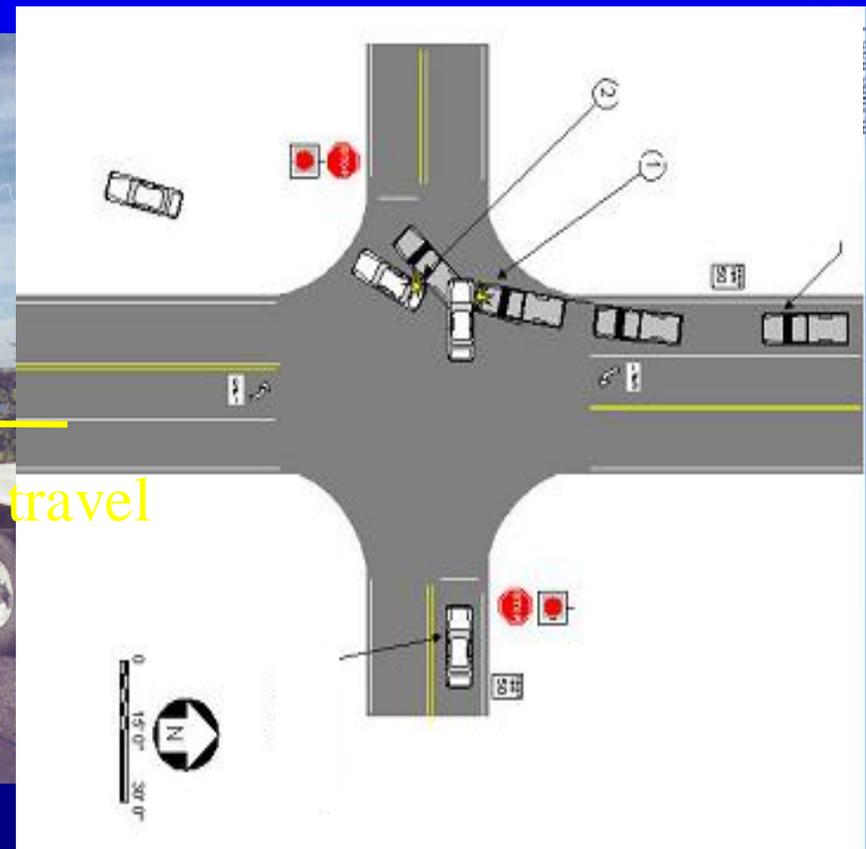
- Two vehicle/ four leg intersection

Approach



Case vehicle travel path

Other vehicle travel path



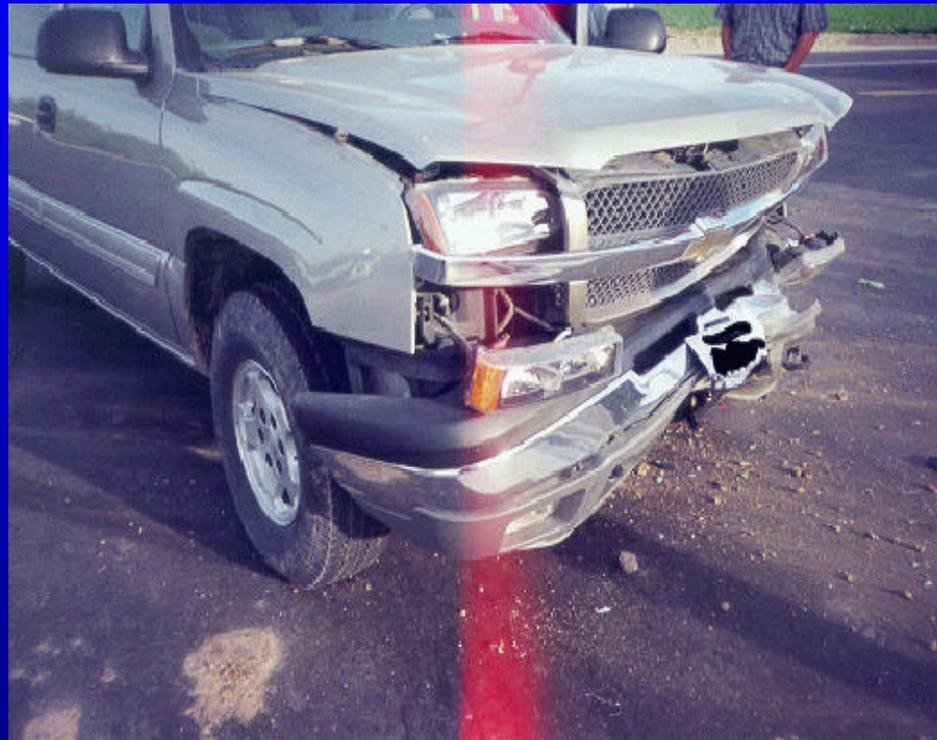
Case Vehicle Data



- **CDC**
 - 12-FYEW-1
- **Safety systems**
 - Stage 1 DAB
 - No PAB deployment
- **WinSmash delta V**
 - -8.7 MPH
- **EDR recorded delta V**
 - -7.02 MPH

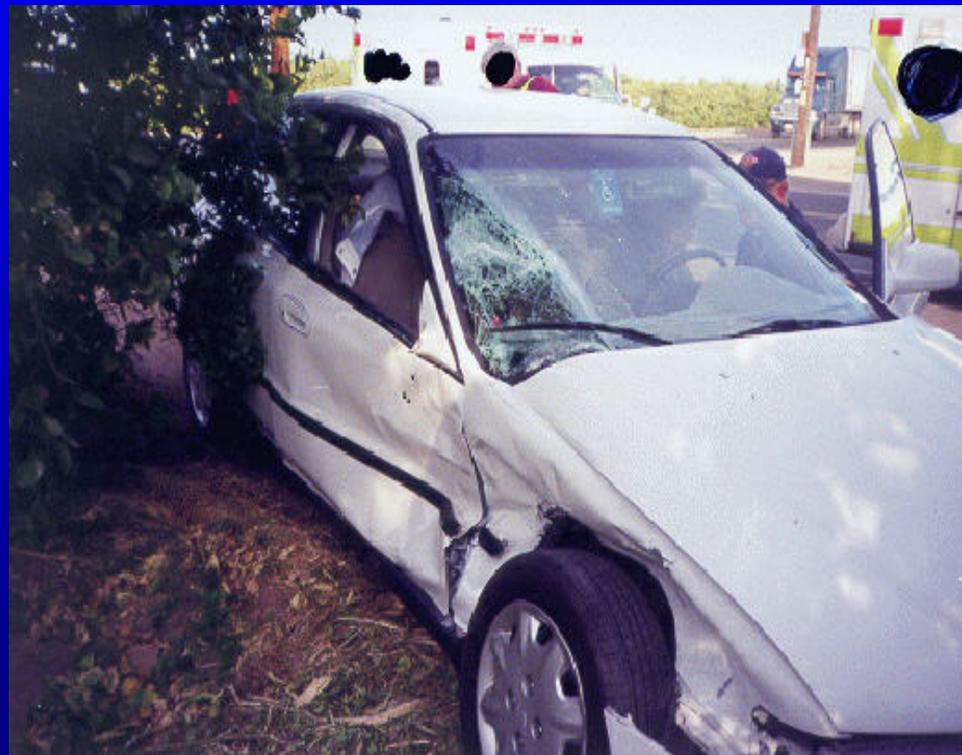
Case Vehicle Damaged View

NHTSA
People Saving People
<http://www.nhtsa.dot.gov>



Other Vehicle

- **1997 Honda Accord**
- **03RYAW2**
- **14.3 mph delta V**



Case Vehicle Driver Data

- 48 YO male
- Unknown ht/wt
- No safety belt use
- Driver air bag stage 1 deployment
- AIS-1 left wrist abrasion
 - Air bag



Case Vehicle Passenger Data

- NOT occupied
- Passenger air bag non-deployed
- Shut off switch set to “Auto”
- System sensed no occupant in RF seat and suppressed the passenger bag



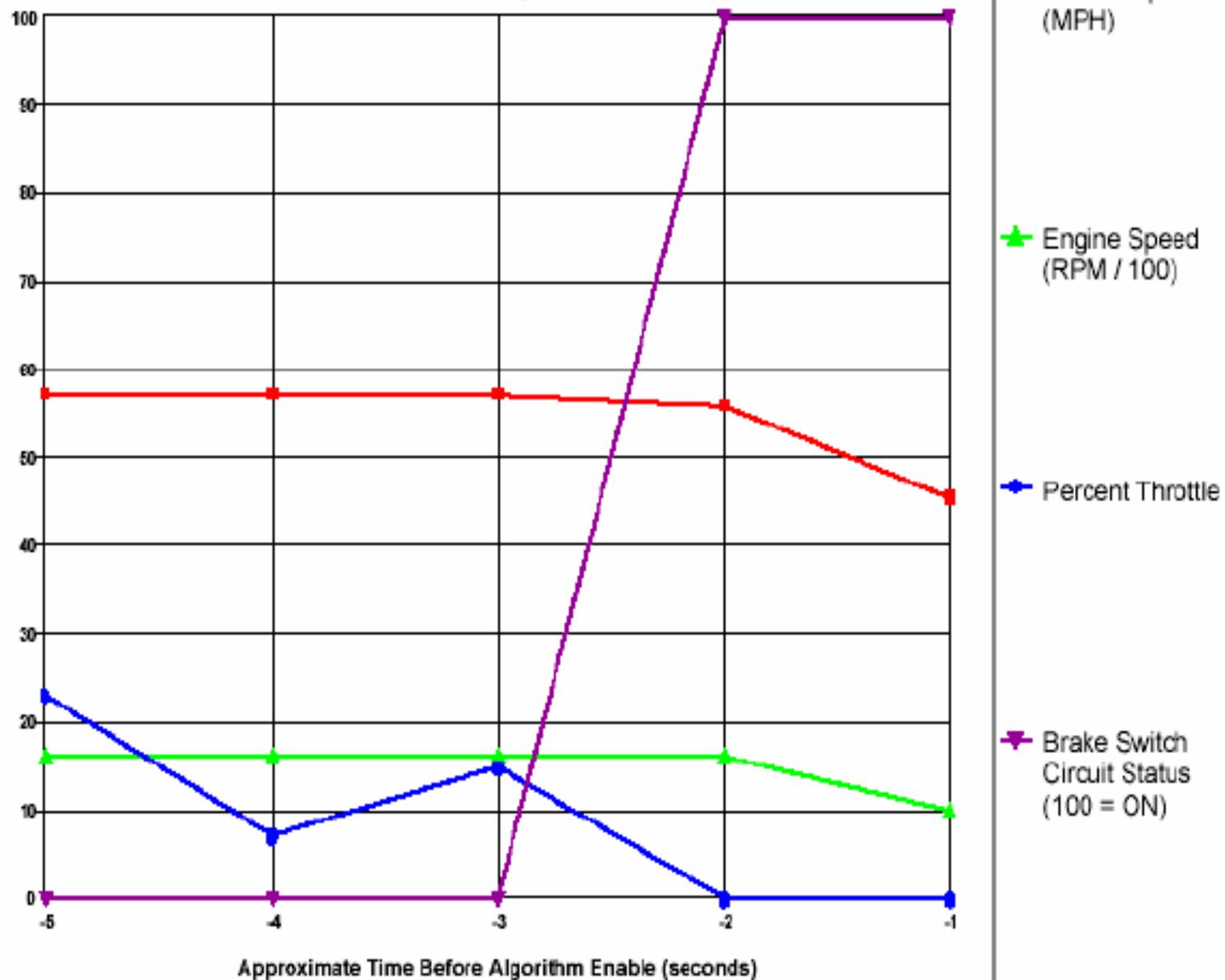
CDR File Information

Vehicle Identification Number	2GCEK19T931xxxxxx
Investigator	
Case Number	
Investigation Date	
Crash Date	
Filename	DS03006.CDR
Saved on	02/25/2003 8:12:53 AM
Data check information	F316BD0F
Collected with CDR version	Crash Data Retrieval Tool 2.00
Collecting program verification number	A31D1C76
Reported with CDR version	Crash Data Retrieval Tool 2.00
Reporting program verification number	A31D1C76
Event(s) recovered	Deployment

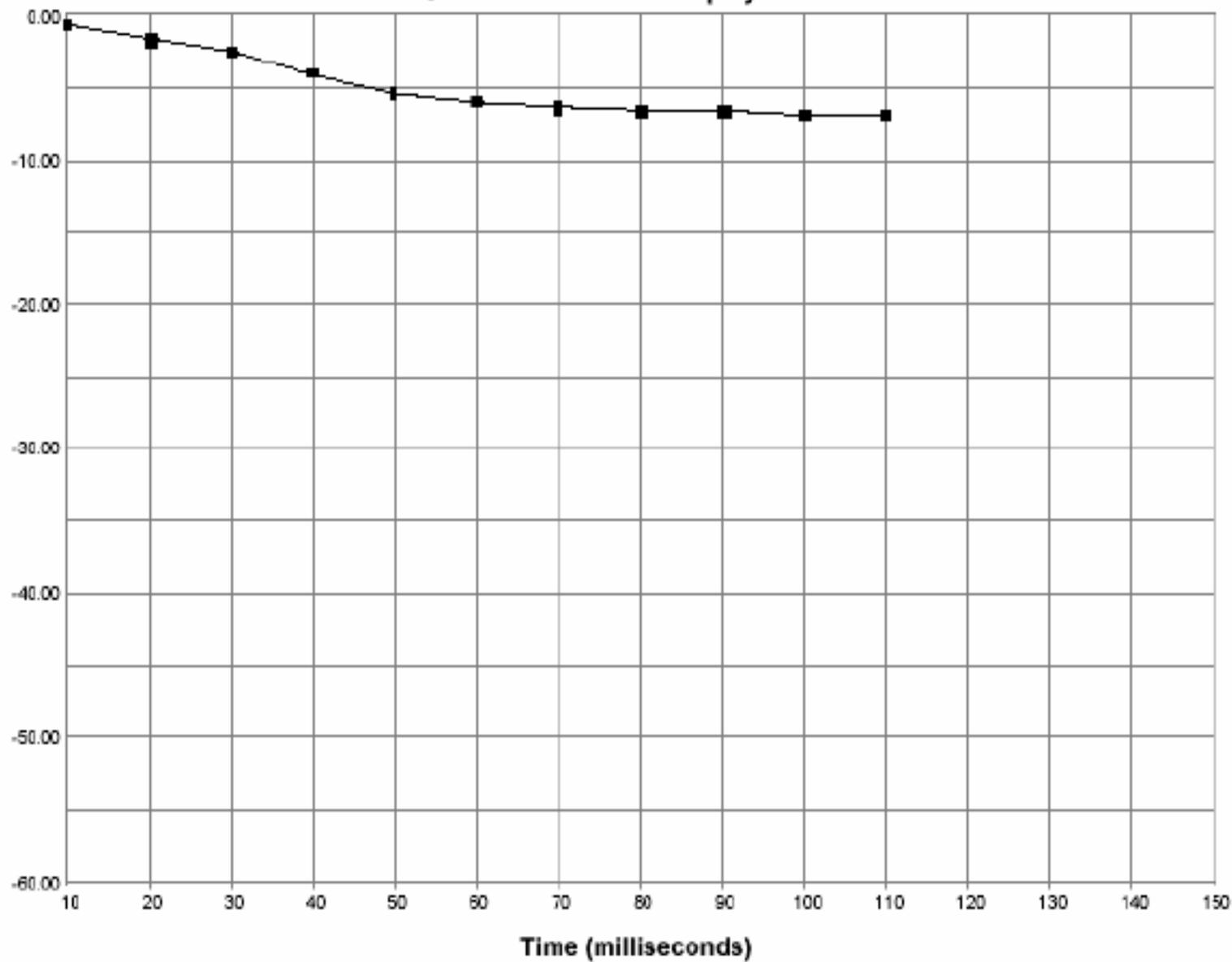
System Status At Deployment

SIR Warning Lamp Status	OFF
Driver's Belt Switch Circuit Status	UNBUCKLED
Ignition Cycles At Deployment	1714
Ignition Cycles At Investigation	1719
Maximum SDM Recorded Velocity Change (MPH)	-7.02
Algorithm Enable to Maximum SDM Recorded Velocity Change (msec)	112.5
Driver First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	17.5
Driver Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger First Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Passenger Second Stage Time Algorithm Enabled to Deployment Command Criteria Met (msec)	N/A
Time Between Non-Deployment And Deployment Events (sec)	N/A
Frontal Deployment Level Event Counter	1
Event Recording Complete	Yes
Multiple Events Associated With This Record	No
One Or More Associated Events Not Recorded	No

2GCEK19T931xxxxxx Deployment Pre-Crash Graph



2GCEK19T931xxxxxx Deployment Data



■ SDM
Recorded
Velocity
Change
(MPH)

The Bottom Line

- **We need the EDR data!**

- **Investigators cannot determine:**
 - **System performance**
 - **When the air bag(s) deployed**
 - **Which stage the air bag(s) deployed**
 - **Timing issues (pretensioners, 2nd stage deployments, disposals)**



Questions?