

AIGA 2006 Meeting

TRANSPORTATION

SAFETY



Asia Industrial Gases Association

12-13 SEPTEMBER 2006
SHANGHAI

Roll-over Prevention

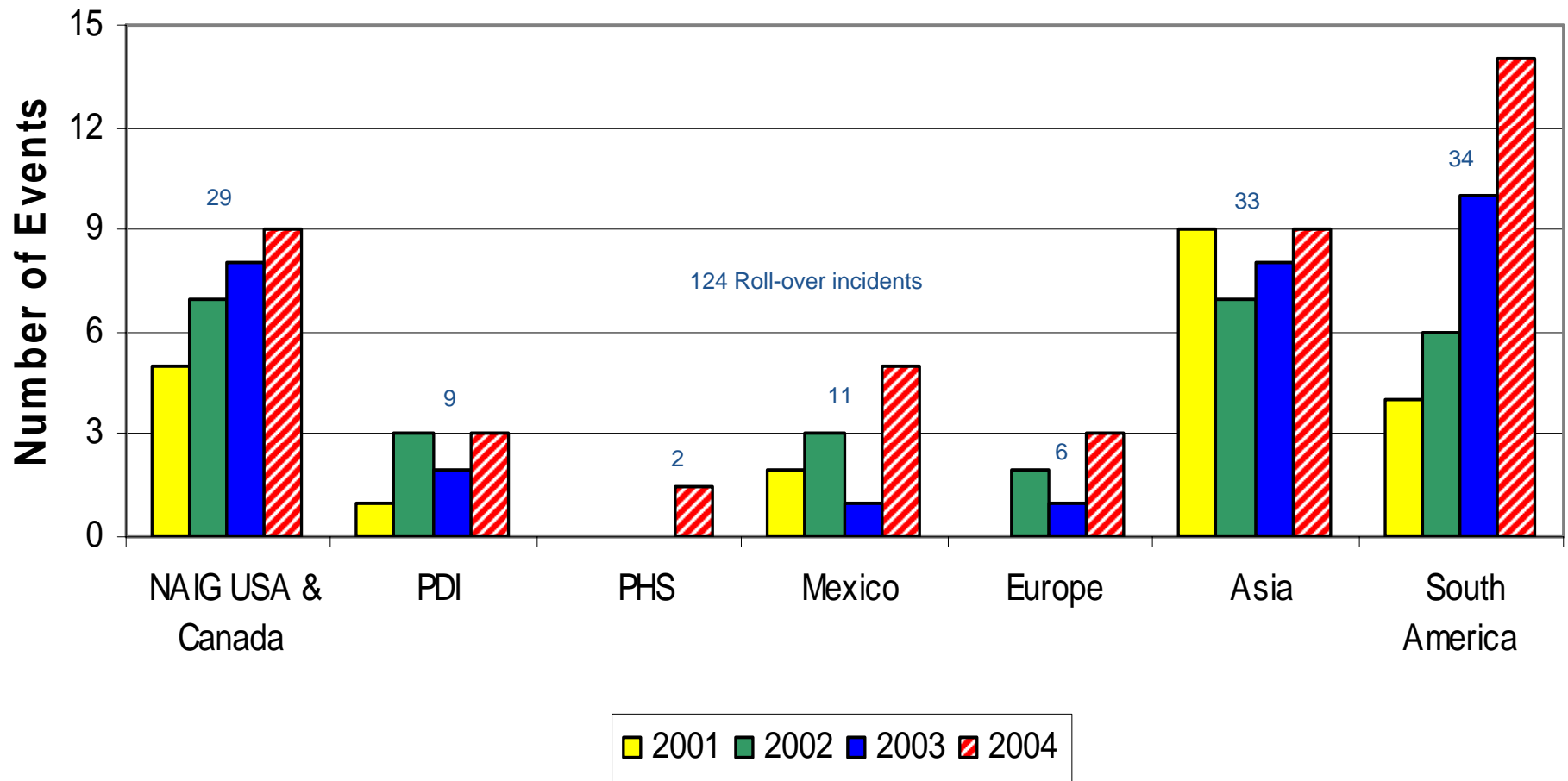


Presented by: Dennis Johnson, Praxair



Roll-over data-Global

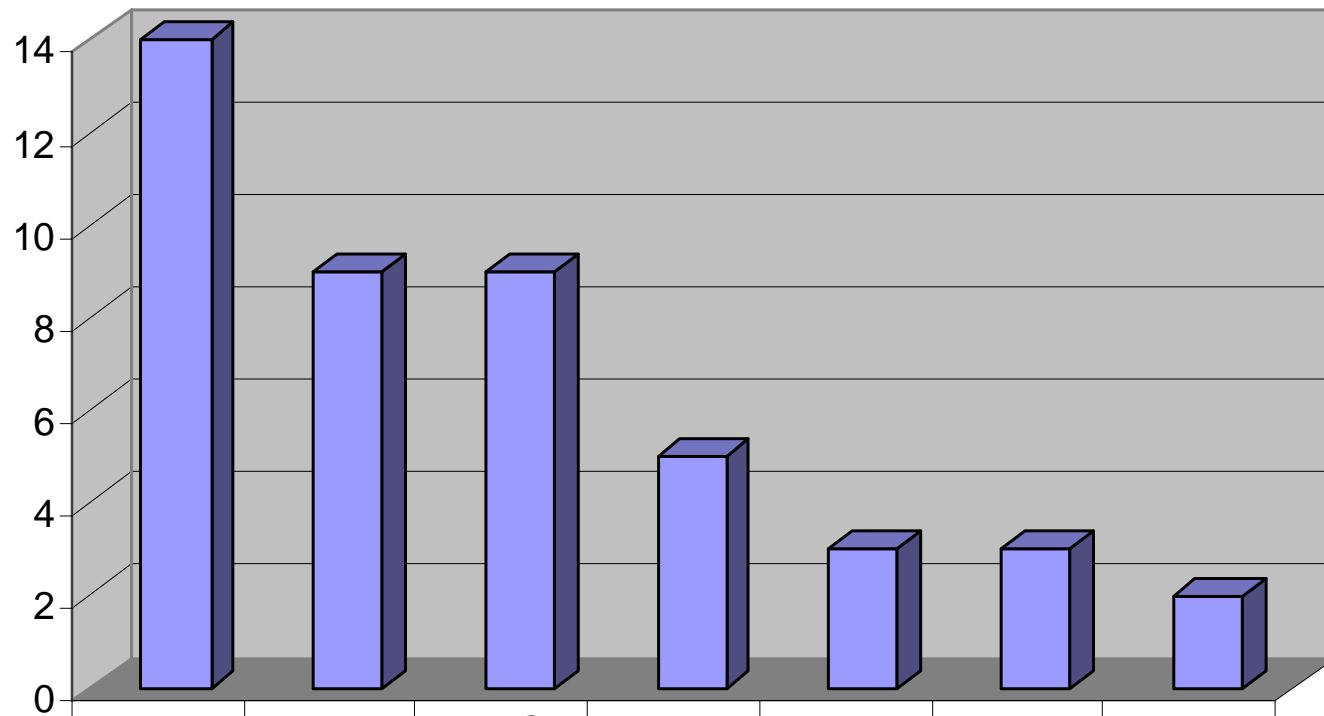
VEHICLE ROLLOVERS: 2001-2004





Roll-overs by WW Group

2004 Roll-overs by WW Groups

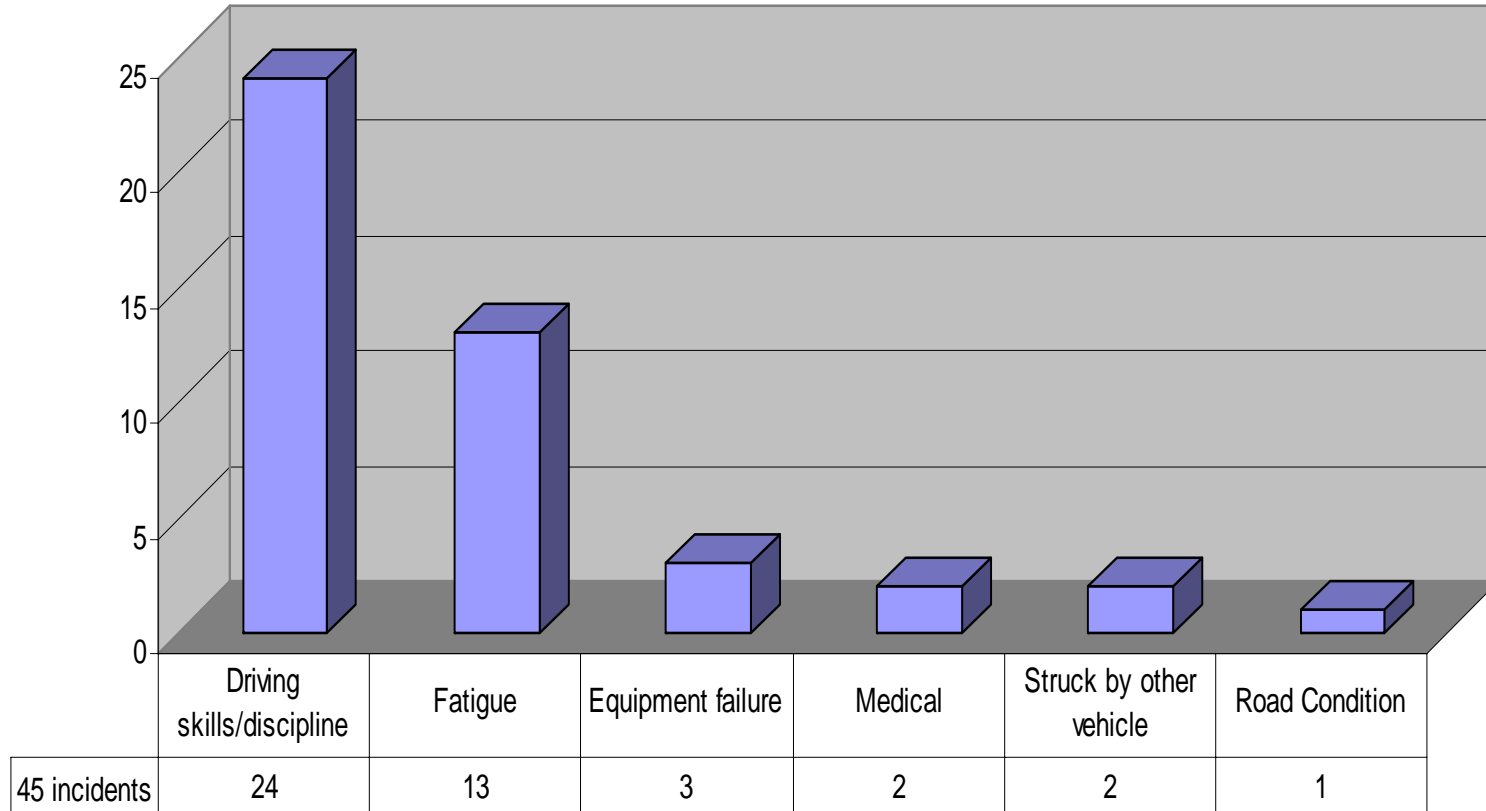


45 incidents	14	9	9	5	3	3	2
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Roll-over cause

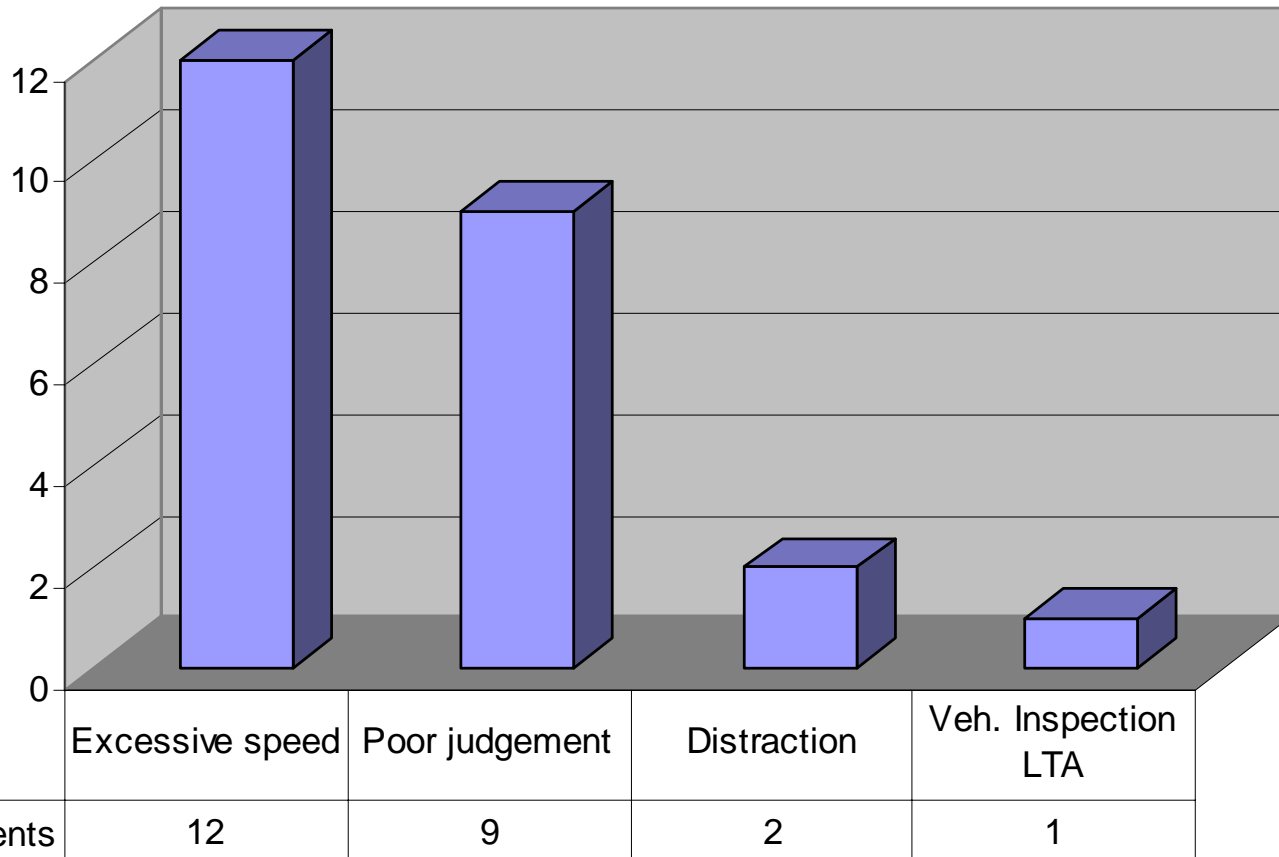
2004 Roll-overs by Root Cause





Driving errors

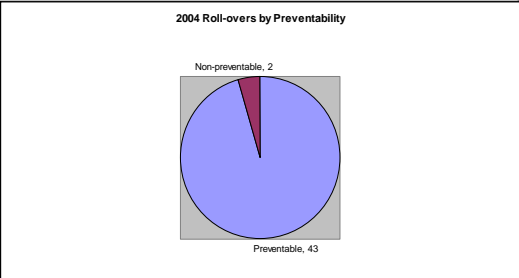
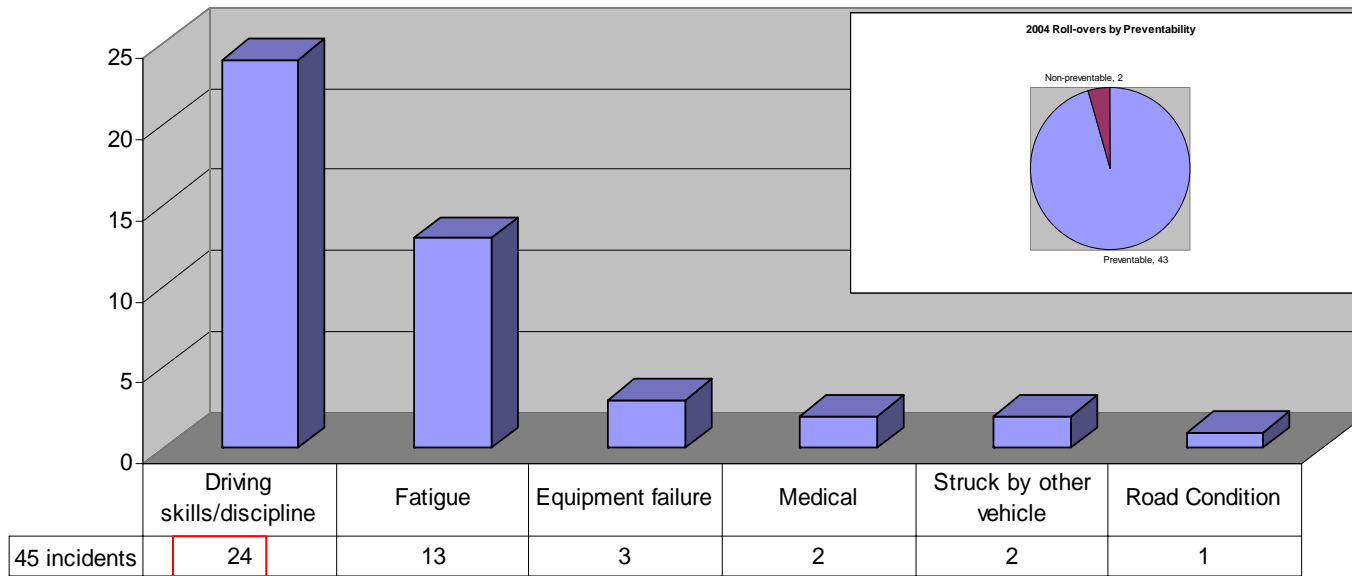
2004 Roll-overs caused by poor driving skills/discipline



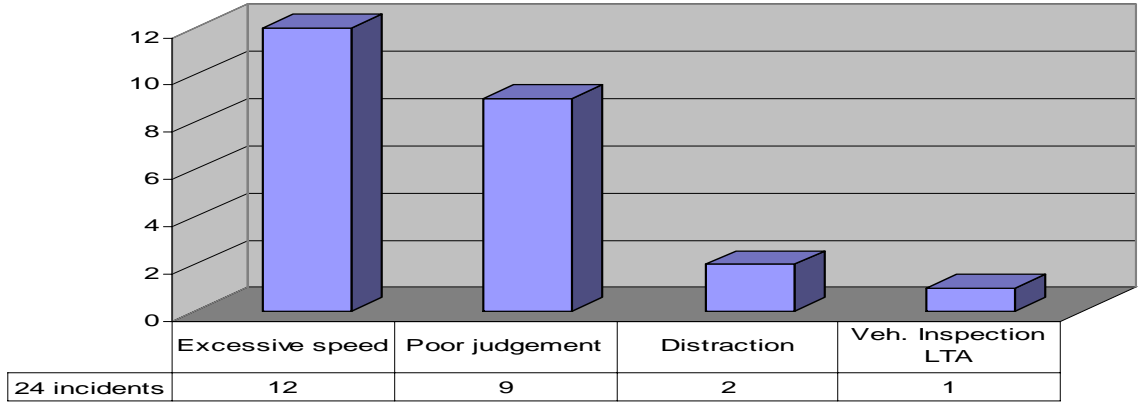


Roll-over data-Global

2004 Roll-overs by Root Cause

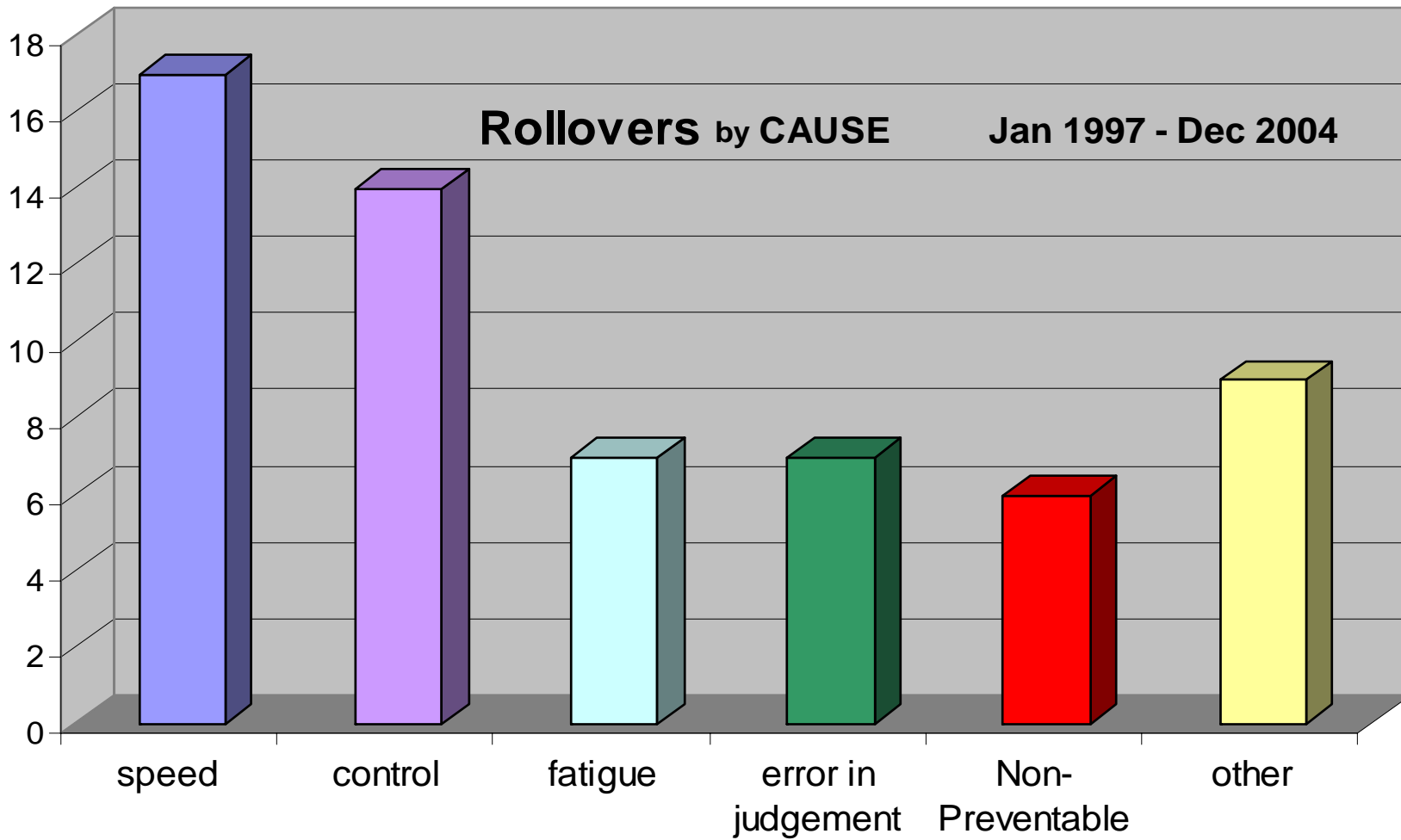


2004 Roll-overs caused by poor driving skills/discipline





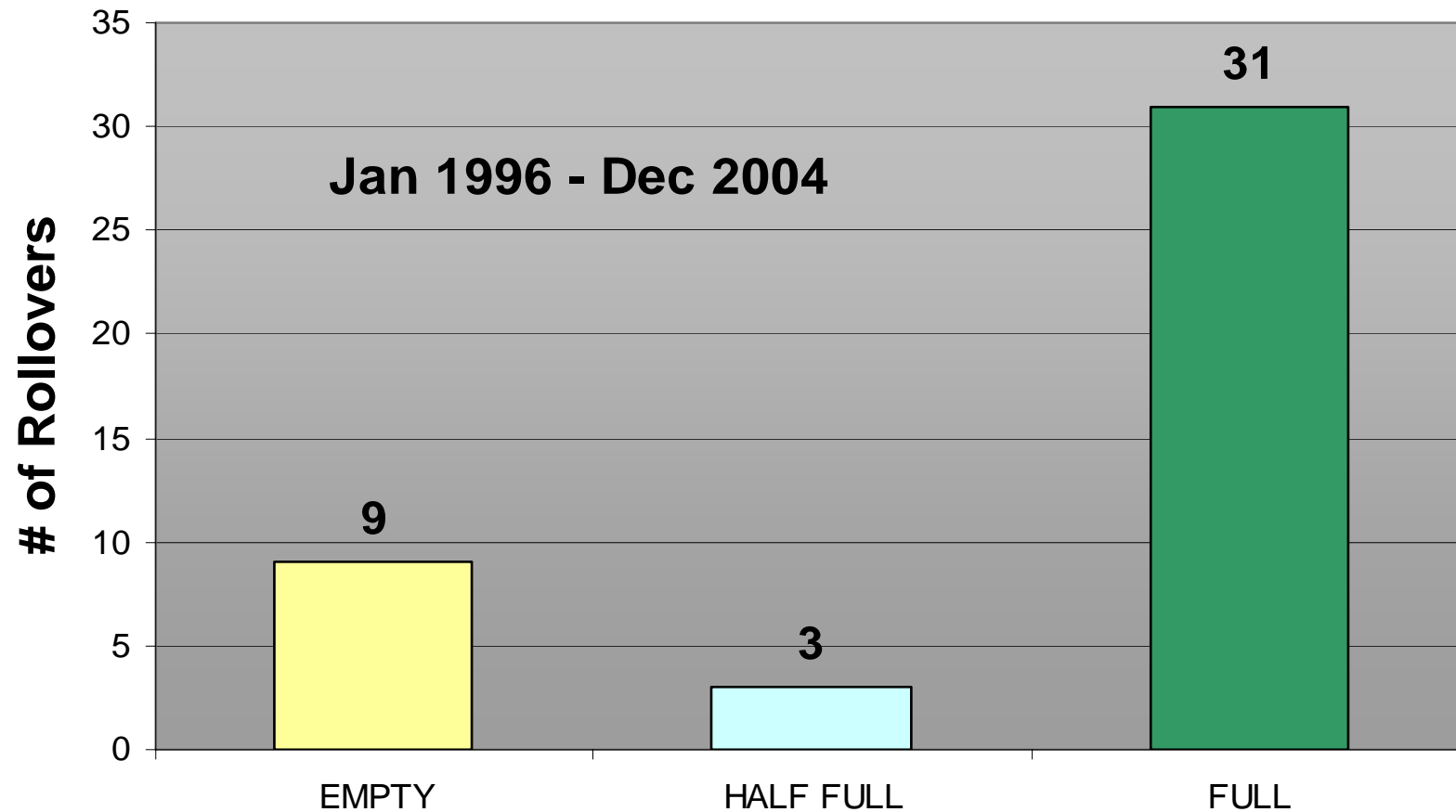
Causes . . .





Trailer Loads .

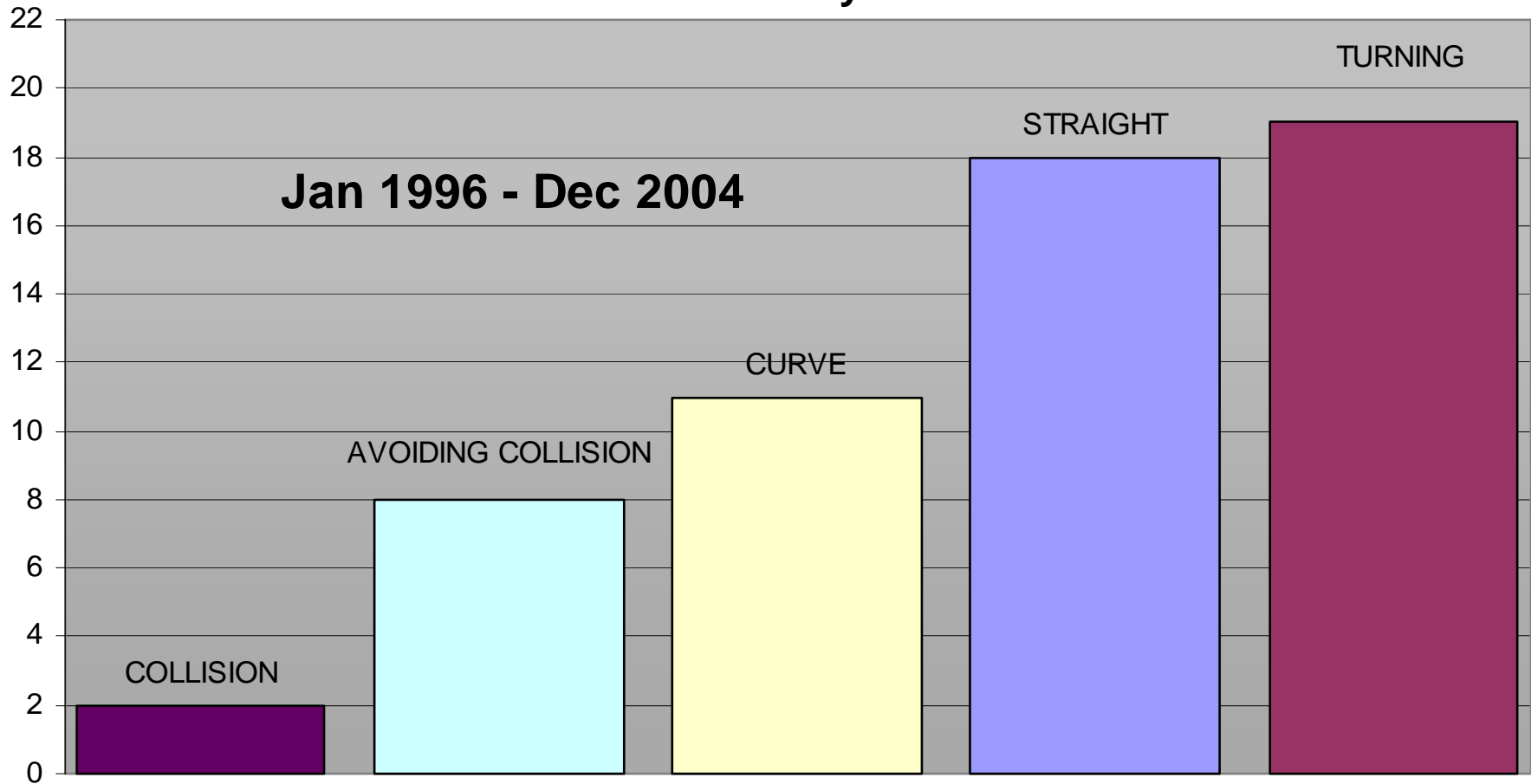
Product Vehicle Rollovers by Trailer Volume





Road Maneuver . .

Product Vehicle Rollover by MANEUVER TYPE





Benchmark - FAA vs. FMCSA

	FAA	FMCSA
Maximum on-duty hours	16 hrs in 24-hr period	14 hrs in 24-hr period 70 hrs in 8 days
Maximum “operating” hours	8 hrs. in 24 hours 30 hrs in 7 days 100 hrs in a month 1000 hrs in a year	11 hrs in 24 hours Weekly limit – on duty hrs No monthly limit No yearly limit
Rest between tours	9 hrs for <8 hr flight 10 hrs for <9 hr flight 11 hrs for ≥9 hr flight	10 hours
Drug & Alcohol Testing	Random testing No alcohol 24 hrs prior to trip	Random testing No alcohol 4 hrs prior to trip
Physical exam requirements	2 times per year EKG one time per year	Every 2 years
Re-qualification Exams	Every 18 months	None required
Relief operators	>8 hrs – one relief pilot >12 hrs – two relief pilots	Relief drivers are optional



Conclusions

- **Most roll-overs occur during bulk transportation**
- **Roll-overs in USA and South America have increased**
 - **In USA, low-speed, soft roll-overs are increasing as service business increases**
- **Roll-overs in other regions have remained almost the same**
- **Fatigue & driver-related issues are the largest causes for roll-overs**
- **Rollover statistics correlate better to number of deliveries than to miles driven**
 - **Rollovers = No. of rollovers / million deliveries**
- **Most rollovers occur when the trailer is full**
 - **High center of gravity (LH₂ trailers) ?**
 - **Fatigue at beginning of trip?**





Deliverables

- **Rollover prevention program with support from all global regions that focuses on:**
 - Driver qualification and training
 - Fatigue and Wellness
 - Identification of New technology
 - Equipment design improvements
- **Roll-over reporting system, data collection and communications database**
 - Excel file accessible by International Regions
 - Questionnaire for use during accident investigation
 - Policy change to ensure timely reporting to S&ES



Prevention Program Focus

- **Drivers**
 - **Driver training**
 - **Praxair Professional Driver Certification showed 44% reduction in vehicle accidents since implementation**
 - **Driver fatigue**
 - Update training
 - Driver survey
 - FAA Benchmarking
- **Engineering**
 - **Equipment design & new technology**
 - **The “Leaner” design**
 - **Electronic Braking**
 - **Stability Control Systems**
 - Meritor/WABCO
 - Bendix
- **Contract carrier management**
 - **Best practices**



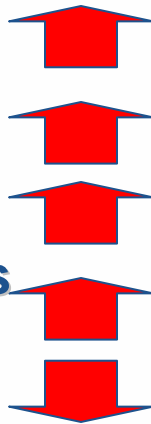
Roll Stability Systems





Need for Stability?

- **Speeds**
- **Incident cost**
- **Liability cost**
- **Driver distractions**
- **Driver experience**



National Statistics (from various sources)

15,000 commercial vehicle rollovers per year (9400 tractor trailers)

1 per 4 million miles (Praxair rate 0.2 per million miles)

58% of driver fatalities occurred in rollovers

Heavy duty (high speed) rollovers responsible for 95% of hazardous material spills

Average \$120k per rollover, jackknives less

Low-Rider Design Improves Stability



- * Lower tractor 5th wheel
- * Lower piping
- * lower 'CG' > improved roll stability





Low- Rider Design Comparison

**Low-Rider
Oxygen**

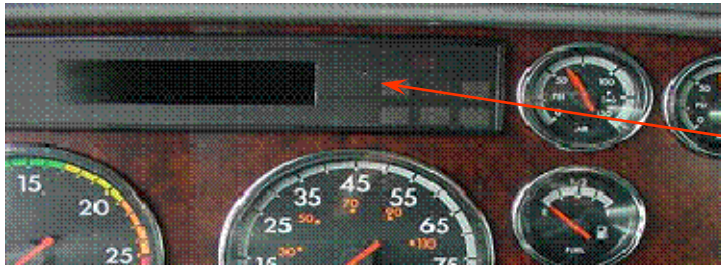
**Standard
Oxygen**

**Standard
Nitrogen**





RSA (Roll Stability Advisor) and RSC (Roll Stability Control)



Message center will display rollover warnings,
message varies with severity of event

o A Freightliner product

- RSA - Post warning system with a display in Message Center, e.g.: “Rollover Risk Detected”, “High Rollover Risk Detected
- RSC -Integrates a rollover control function that reduces power, activates the engine brake and/or applies tractor and trailer brakes when reaching the rollover threshold
- Tested at LaPorte, IN for over two years as part of a Federal funded project
- Statistically significant improvements were found
- Price \$800



Meritor-Wabco Approach

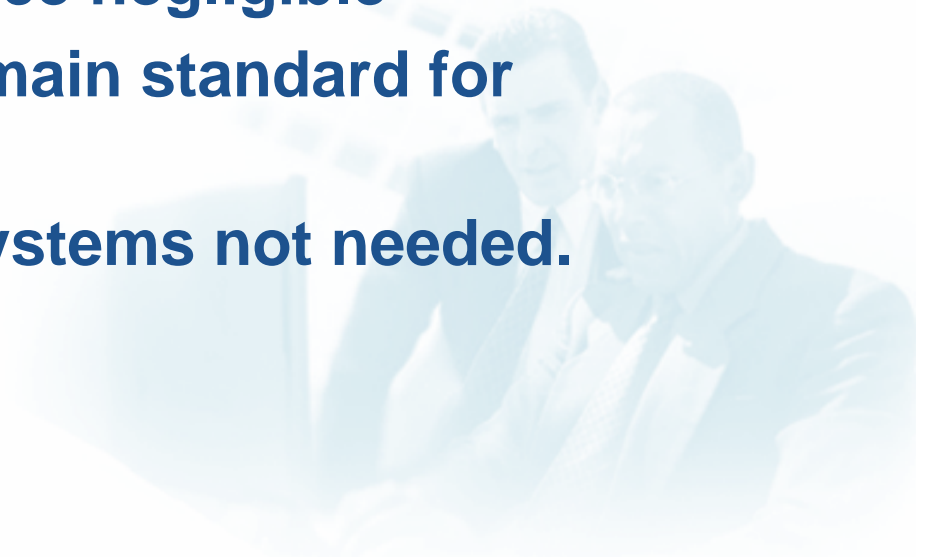
- **EBS is a Natural Evolution of ABS**
 - Pneumatic Logic Replaced by Electronics
 - EBS systems common in Europe
- **Datalink communication with Other Vehicle Electronic Systems**
 - Adaptive Cruise control, lane guidance, etc.
- **Shorten Stopping Distances**
- **Tractor/Trailer are Always Balanced**
- **Ease of Diagnostics and Serviceability**
- **Two systems:**
 - 1. Roll Stability Control (RSC) - Tractor
 - 2. Roll Stability Support (RSS) - Trailer





Bendix Brake System Approach

- **Bendix approach for North America**
 - **ABS-based systems can enable:**
 - **Stability systems**
 - **Integration with other safety systems (Adaptive Cruise, Lane Departure, etc.)**
 - **Shorter stopping distance negligible**
 - **ABS-based systems remain standard for foreseeable future**
 - **Stand alone ECBS systems not needed.**
 - **Tractor based system**
 - **Sensors on tractor**





System Costs etc.

- **Bendix system :**
 - **ABS platform**
 - **Cannot retrofit tractor, must be added on at manufacture**
 - **\$850 Cdn (\$700 US)**

- **Meritor Trailer (EBS) System**
 - **Requires ABS, although EBS platform**
 - **Can retrofit trailer**
 - **Cost approx. \$3000 US**
 - **Sensors on tractor & trailer**





Drivers are Still Key

- **Stability systems are supplemental**
 - Operators should drive normally / prudently
 - Electronics can identify / react to certain situations faster than typical human reaction times
- **System educates the driver**
 - Notify the driver - buzzer / light / brake application / other
 - Learn the limitations of the vehicle
 - Constant change of tractors, trucks, trailers, loads, etc.
 - Discourage drivers that push the envelope
 - Speed reduction beyond stability as a warning



Roll-over Prevention Program

Key Areas

- **Driver training, Operational discipline**
 - Driver Certification
- **Driver fatigue**
- **Equipment design**
- **Equipment maintenance**
- **New technology**
- **Contract negotiations**
 - Carriers
 - Equipment vendors

