RE: ANPRM- Docket No. NHTSA-2023-0012: Side Underride guards

I am writing in response to NHTSA's request for instructive commentary on the accuracy of its research findings on the estimated benefits, costs, of requiring side underride guards on semitrailers.

While my primary focus as a mechanical engineer is motor vehicle accident reconstruction, I am also the founder of a secondary company (Collision Safety Consulting PLLC) that focuses on researching and developing commercial vehicle guarding systems in order to make our highways and roads safer. I have done extensive research on underride collisions and the effectiveness of guards.

I appreciate the opportunity to share some findings involving underride collisions that my office has investigated and I urge NHTSA to consider that the Fatality Analysis Reporting System (FARS) - derived cost benefit analysis (CBA) is inaccurate due to unreliable data sources. Obviously NHTSA is aware of the under-reporting of underride in FARS data. In addition, the data lacks specificity and accuracy and is not sufficient alone as foundational data for NHTSA's analyses and conclusions.

From an engineering perspective, the FARS data does not reliably and accurately report collision details that directly influence the Cost Benefit Analysis (CBA). A primary issue related to the CBA is that NHSTA excludes collisions with vehicle traveling speeds at collision listed above 40 mph. Futhermore, NHTSA estimates that only 19.9% of side underride collisions are at 40 mph or less[1]. However, the FARS relies upon ***estimated*** impact speeds from accident reports. These estimates are often just the roadway speed limit as initial investigating officers rarely have access to event data recorder (EDR) datasets while populating the initial crash report.

This author believes (and is providing supporting data) that traveling speed estimates for underride collisions are usually higher than the true closing velocity of the vehicles involved in an underride accident. Low closing velocity underride collisions often result in catastrophic damage patterns to the upper areas of vehicle structure (which appear to indicate very high closing velocity). This is true as the vehicle greenhouse (windshield, side windows, and roof pillars) of a passenger vehicle are not designed to sustain a collision load and will give way during a collision resulting in catastrophic passenger compartment intrusion (PCI).

An intern in my office conducted a limited case history review and located three 2017 fatal underride collisions where the striking vehicle was equipped with an event data recorder (EDR).

[1] NHTSA does describe 81% of crashes occur in areas where speed limits are above 40 mph. NHTSA implies that a posted speed limit above 40 mph correlates to crash speeds and 40 mph. Furthermore NHTSA does not discriminate between crash speeds and the portion of closing velocity urging underride (penetration velocity)

The redacted accident report and redacted EDR reports are enclosed for each of these three cases (these were the only 2017 cases that the intern found that met the criteria of fatal side underride with EDR-equipped vehilces). The EDR data (last reported traveling speed prior to crash) reported traveling speeds significantly below the estimated speed listed in the accident report in each of these cases. In fact, the actual traveling speed at the last EDR record was on average **15 mph below** the estimated traveling speeds listed in the accident report[2]. This over estimation of pre-impact traveling speeds from accident reports significantly reduces the population of collisions that NHSTA is relying upon for the cost-benefit analysis. FARS relies upon officers-estimated impact speeds, though these estimates are subjective. Data obtained from a vehicle EDR, conversely, is objective evidence that speaks to both pre-impact traveling speed and change in velocity during a collision (delta-v).

To assist NHSTA, ARS PLLC is amenable to allowing NHTSA to review case redacted files for underride collisions to assist NHTSA in understanding underride collisions.

EDR data should be relied upon for evaluating underride guarding efficacy and cost benefit analyses. The majority of modern vehicles are equipped with event data recorders that record both pre-collision and collision data. NHTSA needs to rely upon pre crash data and delta-v data to understand underride collisions in detail.

Related to the above discussion, underride collisions can occur at any vehicle to vehicle orientation and at extremely low closing velocity towards the underside of the trailer[3]. For instance, same direction collisions that occur at high traveling speeds (poorly defined as impact speeds as per the ANPRM) but low closing speeds and low dV are ostensibly excluded from the analysis. For instance, Riley Hein was killed in an underride collision with an unguarded trailer in 2015 when a driver of a tractor trailer changed lanes into his vehicle. Mr. Hein's traveling speed along the highway was approximately 54 miles per hour and the speed of the truck/semi-trailer was 68.5 mph, indicating the initial closing velocity between the semitrailer and his vehicle was 14.5 mph. The actual lateral penetration velocity however was simply the rate of the precipitating lane change conducted by the commercial carrier (maybe 5-7 mph!) Mr. Hein's fatal accident was not included in the FARS data analyzed by NHTSA. NHTSA has excluded entire classes of underride accidents reported in FARS data by conflating estimates of impact speed for closing velocity, penetration velocity, and dV data.

Any time a passenger vehicle or VRU encounters a semitrailer, there is a risk of underride. Underride collisions can happen as a secondary collision and can occur at any angle and vehicle orientation. Accordingly, the FARS data should not be limited to frontal damage patterns only as per the ANPRM appendices. For example, in 2013 Jerry and Marianne Karth's family suffered a

[2] ARS cases 648517, 655316, 661617 enclosed for reference

[3] For the purposes of this document, the portion of closing velocity that is moving a vehicle or VRU laterally underneath the trailer body is defined as the penetration velocity.

double fatal rear underride collision where their vehicle had been prior struck by another commercial vehicle and rotated 180 degrees before impacting and underriding the rear corner of a semitrailer. Given the techniques employed by NHTSA, this collision would have been excluded from consideration in the side guard CBA (if it had been a side crash) due to all of the following limitations:

-High speed limit
-High estimated crash speed
-Non-front collision type
-Three-vehicle accident

The FARS data should be analyzed without limitations described herein to arrive at more accurate accounting of preventable side underride collisions. As prior discussed, a side guard is not required to completely arrest the traveling speed of a vehicle to prevent underride and passenger compartment intrusion (PCI). Vehicles often encounter trailers at oblique angles (two of the three enclosed 2017 cases from the ARS dataset are angled impacts). A guard that redirects the striking vehicle away from the rear trailer axles and away from the underside of a trailer will prevent PCI. NHTSA is degrading and discounting the population of underside collisions and guarding efficacy by over simplifying and failing to address collision mechanics. NHTSA estimates 17 lives saved in the benefit analysis of the ANPRM. This author believes that the true number of lives that can be saved (including motorists and vulnerable road users) is an order of magnitude larger.