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August 22, 2022

Dr. Steven Cliff
Administrator
National Highway Traffic Safety Administration
United States Department of Transportation
1200 New Jersey Ave., SE
Washington, DC 20590

Re: Docket No. NHTSA–2022–0021; Proposal to amend 49CFR563 "Event Data Recorders"

Dear Dr. Cliff:

The following comments are submitted on behalf of the undersigned as the Director of the Collision Safety Institute. For some 22 years now, the Collision Safety Institute has been extensively involved in EDR technology on a variety of levels. The undersigned has been directly involved in training end users in the application of Event Data Recorder (EDR) data to collision analysis continuously since 2000. The Collision Safety Institute's training materials have been based on the hands-on use of EDR data in "real-world" crashes as well as verification and validation of the data through a variety of tests including full scale crash tests.

The Collision Safety Institute has trained EDR data end users ranging from members of government agencies in the US and Canada, engineers from various auto manufacturers, police crash investigators from the local to the state level, to those in private practice including insurance investigators. The undersigned was one of three principal instructors at the first Vetronix Crash Data Retrieval (CDR) Tool Training Seminar in 2000[1, 2] and has been involved in the application of EDR data continuously since then.

Individually, the undersigned served on the NHTSA sponsored "Standardized Event Data Recorder Training Program: A Recommended Curriculum" group (2002-03) and presented at the NHTSA/SAE sponsored industry meeting "Highway Vehicle EDR Symposium" at George Washington University in 2004[3] and again in 2007[4] on the content of what ultimately became 49CFR563. The undersigned has also served as an expert witness at pre-trial hearings and trials on the subject of EDR data more than 50 times since 2003 throughout the US and in New Zealand.

In the current NPRM[5], the Agency has requested comment on a number of areas and the undersigned respectfully submits the following comments in response to those areas highlighted in the NPRM.

- ***Cost estimates and practicality***

Reduced from the NPRM:

> ***"… We are seeking comment on the need and practicability of increasing the pre-crash recording duration … (as well as) … of increasing the sampling rate. …"***
>
> *"… We seek comment on whether current EDRs will need to increase their memory capacity or change the memory implementation strategy (i.e., short term memory buffer verse long-term storage) to meet the new requirements. We also seek comment on our cost estimates and whether our assumptions are accurate. …"*
>
> *"… As discussed in the above section on the cost impacts of this NPRM, the agency believes that no additional hardware would be required by the proposed amendment and that the compliance costs would be negligible, and we are seeking comment on the costs of the proposed rule. …"*

Practicality is strongly associated with cost and the long and short of it is that the Agency has grossly underestimated the cost and potential time required thus making the proposal impractical.

The inexplicably limited discussion in the NPRM with respect to the costs associated with flash memory and tangentially with respect to RAM completely misses a number of actual costs which would be incurred by the OEMs to implement the proposed rule and, by extension, consumers not to mention the potential negative effect on end users of crash data: public and private.

I would acknowledge and reiterate by reference the points made in the Society of Automotive Engineers' (SAE) comment previously submitted with respect to the cost estimates[6, 7] and add that the Agency seems to have wholly lost sight of the fuller scope of the cost of the proposed changes in the recording duration (and sample rate) beyond the more narrowly defined EDR function and overlooks the many associated vehicle components which *does* necessarily mean there will be additional cost and hardware.

The undersigned would concur with the assessment by SAE International with respect to costs: the Agency, through this NPRM, significantly understates the direct and indirect costs of this proposed change. It is clear that the Agency's cost estimate and assumptions are *not accurate* and the NPRM grossly underestimates the larger scope and cost of the proposed changes.

It appears that the Agency has adopted an incredibly narrow view of the cost estimates associated with implementing a change of the proposed magnitude found in the NPRM. In citations 45 and 46 in the NPRM, the focus is clearly on the cost of increasing the flash memory per EDR unit (a) almost suggesting the Agency is of the belief that the EDR is a stand-alone unit, that the memory and/or processor power in the ACM is not in any way shared with the EDR sub-component function. And (b) the NPRM overlooks or simply excludes the associated changes which would have to be made at/to the source components of the underlying data called for in 49CFR563.7(a) and (b) (Data elements).

Assuming that memory (any sort of memory) is *or might* be available in the prevailing market conditions now or in the coming year or so suggested for the timeline for the implementation of the proposed changes, the cost estimates are clearly based on an unrealistic view of the scope of the proposed revisions as well as anticipated prices from 2013 and 2017. Setting aside those price estimates were pre-pandemic/supply chain disruption and predates the current shortage of microchips which prompted the recent 'CHIPS-Plus' bill, one should keep in mind that even that legislation looks at a 10-year timeline to increase domestic chip production (to just 10% of the global market).

The undersigned contends that it is clear that the Agency's time could be better spent in other ways than in pursuit of *this* proposed revision of 49CFR563.

- ***"Need"***

Reduced from the NPRM:

> ***"… We are seeking comment on the need and practicability of increasing the pre-crash recording duration … (as well as) …*** **of** ***increasing the sampling rate. …"***

Relative to this request for comment., taken in three parts, I contend that (1) there is no "need" to increase the recording duration. That said, (2) a case can be made for an increased data sample rate to be phased in over a more reasonable period than suggested in the current NPRM that would also (3) also allow for necessary and practical corrections and revisions of 49CFR563 which have been lacking since its implementation in September 2012.

- ***There is no "need" to increase the recording duration***

Included by reference is the "SAE EDR Committee's Response to NHTSA's Report to Congress on the Event Data Recorders (EDRs) Duration Study"[8]. The instant NPRM relies heavily on the conclusions offered by Chen, et al[9] in proposing the increased (pre-crash data) recording period/duration. Not one to "take the long way around the barn," the undersigned contends that Chen, et al (the "EDR Duration Study")[10] is replete with factional errors and substantial misstatements associated with EDR technology and undermines the reliability of the "EDR Duration Study" as the basis for the proposed increase in recording duration.

At the risk of rehashing the entirety of the EDR Committee's response, suffice it to say that I concur with the Committee where it correctly pointed out:

> "… There are at least five issues with the data used in the VT Study:
> 1) the three elements chosen were studied individually as a subset of data and not with the rest of the EDR data as a crash record should be;
> 2) the vehicles analyzed in the study lacked modern safety features;
> 3) the authors made a number of flawed assumptions;
> 4) the authors purposely ignored EDR data that exceeded 5 seconds as stated in section 3.1.4 pre-crash maneuver time calculation (p6); and
> 5) the recording frequency of the older vehicles used in the report was at a much slower sample rate, 1 hertz, versus the 2 hertz frequency of the data stored in newer Part 563 vehicles. …"[11]

Although these and other shortcomings of the "EDR Duration Study" remain unaddressed in the current NPRM, the Agency has wholly adopted the "EDR Duration Study" without meaningful critical review or analysis as the basis for the extended recording duration (and sample rate) proposal.

At its core, the data making up the basis for the "EDR Duration Study" has a "weighted median vehicle model year (of) 2006.[12]" Not to loose sight of the fact that median year model (2006) is 6 years *before* the implementation of 49CFR563 and a poor comparison to the state of EDR technology in 2012 or later, the bulk of the MY06 vehicles had pre-crash data which had little, if any, resemblance to the data elements found in 49CFR563.

In "Phase 2," Chen, et al went on to discuss driver actions in "normal driving" scenarios by examining data from Naturalistic Driving Studies. However, Chen, et al did not actually compare the data relative to whether or not it would assist with crash causation analysis in the "EDR Duration Study." Nonetheless, the study is offered as the lone basis for the extended recording duration proposal of 20 seconds pre-Time Zero[13].

In the "EDR Duration Study" the focus was exposed in the "Approach" section where we find this passage:

> *"… In the first phase, the project has examined the frequency with which EDRs failed to capture driver pre-crash actions. …"[14]*

Setting aside how this seems an awful lot like a conclusion in search of a study, one has to wonder how the authors objectively established that there were actions *before* the five second period what was important during that period that might have been "missed" because of the "5 second limit."

However, pointing out the lack of actual justification for the expansion of the recording duration found in the "EDR Duration Study" doesn't really directly answer what should have been the question: is there a *"need"* for an extended pre-crash reporting period. However, the better question might have been posed as: does 5 seconds of pre-crash data adequately represent a period which might be used to better understand the "how" or "why" a crash happened?

Before the public release of the CDR Tool, before February 2000 and – really as EDR data began to mature into the early 2000s – crash analysis was based on finding speeds and driver behaviors *at and immediately before impact*. Crash analysis was and always has, even to today, been based on the collection and evaluation of tangible information from the crash including roadway marks, vehicle damage, injury patterns ... the sort of thing that might ring familiar if it were referred to as the "Haddon Matrix:" the human, vehicle, and environmental (HVE) aspects of a crash.

But what if we were able to examine data from actual active safety systems presently on vehicles more representative of those covered by 49CFR563 than model year 2006 and, from that, better evaluate what "the car" might have "seen" when and where before a crash? If we can determine where the car's active safety system(s) "detected" a hazard and assume the driver may have similarly been able to see and respond to the hazard and determine the time prior to the crash, that might be a better way to evaluate an appropriate period of pre-crash data recording. That might be a period sufficient to capture a meaningful snapshot of driver behavior if that is to be the shifting goal of 49CFR563.

Aside from the limited volume of retrievable active safety systems on the road, a significant limitation of this approach is that active safety system data is virtually never collected in the "near-miss" or minor severity crash. Another way to put it is that *if there was not a crash or if it was "minor," there's not going to be a "crash investigation."* That means there will not be data retrieved. Police agencies do not have time, resources, or manpower to "prove a negative." Therefore, the only time we might get active safety system data is as a function of testing or in a scenario where the active safety system detected a hazard and alerted the driver but there was still a reportable crash.

As it relates to data access and retrieval using the Bosch CDR Tool, starting with about model year 2013, select GM vehicles may have active safety or driver assistance system data stored in the Active Safety Control Module (ASCM) or Front Camer Module (FCM). Certain VW vehicles may record Non-Deployment events as a function of Automatic Emergency Braking (AEB) and other vehicles may record other data elements which could, after further investigation, be associated with AEB, however, they may not be readily identified as such.

In the larger universe of "EDR data," diver assistance system data may be considered "the unicorn" of crash data: if the system works effectively as designed and the driver doesn't "outdrive" the system, there is no crash, so there's no investigation and, by extension, there would be no data retrieved. For that reason, there are a finite number of examples of CDR Tool retrievable active safety system data sets available.

In an effort to determine if ASCM data was available to the Agency for this proposal using a more current version data stored in the NASS/CDS data base than the "EDR Duration Study"[15] I explored the Crash Investigation Sampling System (CISS). Where the NASS/CDS data used by Chen, et al was limited to the years 2000-2015, the data at CISS includes investigations in 2020 which may have included ASCM data. At CISS, I conducted a filtered search, making it ever narrower to identify potential ASCM data sets.

Initially, through CISS, I identified some 305 potential investigations which, on the surface, had the potential for ASCM data[16]. In the end, I was able to filter that number to 48 investigations in 2020 involving 3 Buick, 20 Cadillac, 23 Chevrolet and 2 GMC vehicles in crashes using model and model years identified in the most recent year of CISS (2020) which, according to the Bosch CDR Tool Vehicle and Cable Lookup, may have had ASCM data. In that group, out of the forty-eight investigations, there were no instances of data retrieved from an ASCM whether or not it was present on the involved GM vehicle[17]. In some cases, a then out of date version of the Bosch CDR Tool software was used to access whatever data was retrieved and there is no mention of whether or not the necessary interface module was available or used or if the imaging Technician even looked for or knew to look for ASCM data.

- *Current Active Safety System examples of sufficient duration*

The Insurance Institute for Highway Safety (IIHS) conducted 18 AEB tests on a 2019 VW Jetta in September 2018. The last two of those tests (tests 17 and 18) survived the follow up data recorded as a function of the Moderate Overlap Front Test conducted by IIHS in November 2018[18].

In what is identified as "Test #17," the AEB event was recorded in the EDR as an "External Trigger event" – a Non-Deployment event – where the approach speed was 30 km/h with ABS braking to a stop. The data confirms that no driver application of the brakes occurred, however, ABS braking was initiated between 1 and 1.5 seconds before the indicated "time zero[19]." Since the apparent logic for an "external trigger" event to be recorded is after the event is "over" (collision avoided) the AEB application of full brakes into ABS activity was initiated at 1 to 1.5 seconds before the vehicle was reported at a stop[20] (speed = 0 km/h).

In what is identified as "Test #18," the entry speed was 29 km/h with ABS activity at about 1.5 seconds before the apparent "time zero." Recognizing that this data in both instances was captured at 2 samples per second, I have adopted the same strategy found in the "EDR Duration Study" – rounding the time of initiation *up* to the preceding sample time.

In both examples, the driver assistance system behavior as a function of the car engaging ABS braking to avoid the collision was easily captured and recorded within the 5 seconds of pre-crash data (duration).

There is currently more than one variant of GM Active Safety Control Module (ASCM[21]) which may record data which that may be accessed and retrieved using the Bosch CDR Tool. These systems capture data every 80 ms for about 4 seconds before a data recording trigger threshold is met.

A number of associated data elements are currently captured and then, when appropriate, recorded by the ASCM *including, among others*:

Vehicle Speed (km/h)
ASCM Longitudinal Acceleration (m/s^2)
ASCM Lateral Acceleration (m/s^2)
Brake Pedal Position (%)
Service Brake (Brake Switch Circuit State)
Driver Initiated Braking (True/False)
Accelerator Pedal, % Full (%)
AEB Object Lateral Position (meter)
AEB Object Longitudinal Position (meter)
AEB Object Time to Collision (Sec)

For this analysis, and in keeping with the "EDR Duration Study," data elements for brake switch status "ON/OFF," nonzero steering and accelerator pedal data were examined for a group of 10 data sets from MY2015-2019 GM ASCMs. To then examine where the ASCM might have "seen" a potential hazard the data elements "Vehicle Ahead Indication," and "AEB Object Time to Collision (Sec)" were included in the analysis. The initially recorded vehicle speeds varied across the examples from 17 km/h to 95 km/h.

In only 1 of 10 sets of data, the brake switch circuit status showed "ON" at the oldest sample point (the "-3.92 sec" sample). For the remaining 9, the earliest point where the "Service Brake (Brake Switch Circuit State)" changed to "True" or "ON" was at the -2.72 sec sample set. In the one example where there was a brake switch "ON" indication at the oldest sample in the set, the data element "Brake Pedal Position (%)" was recorded as 29% and the indication for the data element "Driver Initiated Braking" at that point was "true." In that example, the "Driver Initiated Braking" element translation changed to "False" at about -1.44sec and the "Brake Pedal Position (%)" changed to 11% with the "Service Brake (Brake Switch Circuit State)" remaining "True" or "ON."

In the example ASCM data, where the accelerator pedal status was non-zero at the oldest sample and changed to zero, that change was observed at the "high end" around -3.44 sec and, on the "low end" at about -2.4sec before the established "time zero[22]. Again, all within the 3.92 sec of data.

Steering angle – measured in the ASCM to a far higher range than called for in 49CFR563 – was more of a "moving target" in this data set. Adopting that as much as approximately "15 degrees of steering at the steering wheel" may only result in a 1-degree change at the steered wheels, 6 of the data sets were at or under that threshold at the -3.92 sec point and none of those showed data which would suggest an evasive steering maneuver at any point leading to the event recording trigger. One set of data showed some 486 degrees of steering in a positive direction which, by the end of the 3.92 second period, changed to negative steering. In that one data set, for that one element, having more than 3.92

seconds of data might have been useful, however, from the remainder of the data, what was going on at the time may be deduced from the totality of the data recorded.

> ***The reader who may have looked at those last few paragraphs and was thinking: "that's a lot of detail to offer in this comment," well, that is exactly on point: all that (and more) was captured and recorded in the roughly 4 seconds – not even a full 5 seconds – of pre-trigger data and should drive home the observation that a longer duration set of data really isn't necessary.***

Of course, there are times where a longer duration snapshot of "pre-crash" data might be useful but in the vast majority of crashes, 5 seconds of pre-crash data is sufficient. There is no doubt many of those of us involved in crash analysis would *"like"* to have "more data" but most of would rather have more uniform, clearly explained data than data which would more often than not be well beyond the scope of the immediate investigation. When weighed against the potential cost, the *"wanting"* more pre-crash duration *doesn't rise to the level of a "needing" more pre-crash data.*

In all 10 example ASCM data files, the "AEB Object Time to Collision (Sec)" was either a maximum value (99.9 or 99.875 sec) or greater than 4 sec at the -3.92 sec point[23]. In one of the examples, where the "AEB Object Time to Collision (Sec)" was 5.075 sec at the -3.92 sec point, it became a maximum time at -2.56 sec. In 9 of the 10 examples, the 3.92 sec period was sufficient to capture meaningful change in vehicle/driver actions before the recorded event. In 7 of the 10 files where there was a "FCA Alert Indication" or "Vehicle Ahead Indication" it occurred at a maximum time of -3.28 sec. In the instance closest to the event trigger, the alert came at the 00.48sec point. Setting aside the 5 sec called or in 49CFR563 – not to mention that these data elements exceed that called for thin the regulation - all were within 4 sec of the event trigger.

- ***A duration of 20 sec just isn't necessary or justified against the larger potential cost.***

The other accessible GM system which captures driver assistance data is the Front Camera Module (FCM) generally associated with a forward collision alert (FCA) of some sort (pedestrian or vehicle) or a drift out of the driver's lane of travel. The FCM captures data and a single low-resolution photo at the time the FCM triggers an alert to the driver and then a corresponding photo and data set 4 seconds before that and 4 seconds after that alert or trigger.

As with the ASCM data, FCM data is difficult to come by inasmuch as there has to be a crash, of a certain type, which would qualify for recording in the FCM, and, of course, an investigation of some sort where the data might be retrieved. Where the FCM performed as anticipated and the driver didn't overdrive the system, there was no crash and, of course, no investigation, no data is retrieved for review.

While there were, as with the ASCM, no FCM data files in the CISS database, I reviewed 12 FCM files retrieved using the Bosch CDR Tool. While the elements are not in keeping with the provisions of 49CFR563 – nor would they have to be inasmuch as there's really no "time series" data and FCM data isn't necessarily associated with the notion that it might be "…intended for retrieval after the crash event. …" the data elements which are present may include, among others:

UTC Date at Event	Current AEB Type Setting
UTC Time at Event	Vehicle Speed Average Non Driven (km/h)

Vehicle Acceleration - Longitudinal (m/s^2)
Vehicle Acceleration - Lateral (m/s^2)
Yaw Rate (deg/sec)
FCA Alert Indication
Accelerator Pedal, % Full (%)
Brake Pedal Position (%)
Service Brake (Brake Switch Circuit State)
AEB Object Type
AEB Object Longitudinal Distance (m)
FCA Gap Customer Setting

In the 12 files reviewed I excluded lane departure warning events and focused instead on "Collision Imminent Braking," "Pedestrian warning," and "Pedestrian braking" events. As with the ASCM data, the design observation period is less than 5 seconds which begs the question: does that period yield a sufficient snapshot[24] of the collision event?

In the Pedestrian related events, the pedestrian target was detected consistently at approximately 30m ahead of the vehicle when the vehicle was traveling at 11-24 km/h at about 4 sec before the event recording trigger. In the Collision Imminent Braking events, the vehicle speed observed as between 41 and 71 km/h and the distance to the target vehicle was, at approximately 4 seconds before the driver alert, some 16 to 36m with the closer distance also reflecting a target relative velocity such that the target was "pulling away" as the FCM equipped vehicle was slowing.

As with the ASCM data, there's a lot of information available and one should not lose sight of the fact that it was all captured easily within the 4 sec around an alert or warning to the driver. Moreover, in all the examined FCM files, there was minimal driver response (i.e.: simply releasing the accelerator pedal) driver to driver braking *but all occurred within the "4 seconds* before event trigger" data capture and the "event trigger" capture.

While there is no reasonable justification for increasing the duration of data recording before "Time Zero[25]" given state of emerging data technologies there is a benefit to increased sample rate within the 5 second pre-Time Zero period.

When the earliest Pre-crash data was captured at 1Hz it was common, in the EDR end user community, to acknowledge that "a lot can happen in 1 second (pre-crash)."' That remains true today even at a sample rate twice that frequency. Undeniably, crash analysis might be improved with an increased sample rate but that has to be weighed against the cost to the OEMs and, by extension, the consumer of that implementation. While some OEMs (i.e.: FCA) already take advantage of a 10Hz sample rate, other OEMs (i.e.: GM) have rolled out ACMs which capture 8 seconds of pre-crash data while still at a 2Hz capture and recording rate.

The industry is organically moving in the direction of more data elements and a higher sample rate without government prompting.

What remains to be addressed, however, is the portion of the NPRM which touches on the subject of "plain language" and the final question posed: "What else could we do to make the rule easier to understand? …" is, I believe, directly on point.

As it has been applied over these past 10 years, if we've learned anything about 49CFR563 it is that it's not standard and it is riddled with vague, ambiguous, even contradictory, elements. In a response to Docket No. NHTSA–2012–0177 associated with the proposed "conversion" of 49CFR563 to a FMVSS, the undersigned spoke out about unresolved conflicts within the existing regulation and I believe strongly that those should be addressed before significant components – specifically the duration and frequency of data collected the regulation – are changed: let's get the underlying regulation right before we start changing duration and frequency.

It is the position of then undersigned that the Agency would be far better served "dragging 49CFR563 kicking and screaming" into the current state and near-term future of EDR technology rather than trying to put a band aid on the regulation as it now exists by focusing on things like duration and sample rate. A harmonized "Time Zero," a closer look at polarity conventions, inclusion of and clear definitions for data elements which, for example, might be associated with hybrid or electric vehicle should command the Agency's attention before changing duration and sample rate.

As the regulation stands now, changing duration means we get more data which is, in many ways, inconsistent across different OEMs … but at least we get more of it. That's really not a solution and not a way to advance traffic safety.

I would offer my experience and background toward a more detailed examination of the contents of this comment. If you have any questions or require further information, please contact me at rustyhaight@collisionsafety.net.

Thank you for your time and consideration

Sincerely,

W. R. Rusty Haight
Director

[1] By way of a little history, in the late 1990's General Motors worked with Vetronix Corp. – a scan tool manufacturer which was based in Santa Barbara, CA – to develop the original Crash Data Retrieval (CDR) Tool becoming, in February of 2000, the first publicly available tool which would be used to access and retrieve crash data in passenger cars, light trucks and SUVs. In 2003, Robert Bosch LLC bought Vetronix Corp. Over time, the most widely used Crash Data Retrieval (CDR) Tool in the world has become known simply as the "Bosch CDR Tool."

[2] Rather than placing footnotes at each page, references and notes have been included as endnotes.

[3] Haight, W. R., "Overcoming Unrealistic Expectations of EDR Data," NHTSA / SAE "Highway Vehicle EDR Symposium," 2004, George Washington Univ NHTSA Academy, Ashburn, VA

[4] Haight, W. R., "Practical Application of EDR Data and Data Validity," NHTSA / SAE "Highway Vehicle EDR Symposium," 2007, George Washington Univ NHTSA Academy, Ashburn, VA

[5] Docket No. NHTSA–2022–0021; Proposal to amend 49CFR563 "Event Data Recorders"

[6] SAE International Comments to: NPRM – Part 563, Event Data Recorders, Minimum time Capture for Pre-Crash Data, U.S. DOT – National Highway Traffic Safety Administration [Docket No. NHTSA-2022-0021], August 19, 2022; signatory S. William Gouse as found at "3. Hardship to Automotive Manufacturers"

[7] The undersigned is also a 32-year Member of the SAE International and offering this comment separately from that submitted by the SAE.

[8] Dated 6/3/2020 under a cover letter signed by S. William Gouse, Director, Federal Programs, SAE International.

[9] Chen, R.J., Tatem, W.M., & Gabler, H.C. (2017) Event data recorder duration study (Appendix to a Report to Congress. Report No. DOT HS 813 082B). National Highway Traffic Safety Administration; as reference 7 to the NPRM

[10] Chen, R.J., Tatem, W.M., & Gabler, H.C. (2017) Event data recorder duration study (Appendix to a Report to Congress. Report No. DOT HS 813 082B). National Highway Traffic Safety Administration; as reference 7 to the NPRM

[11] "SAE EDR Committee's Response to NHTSA's Report to Congress on the Event Data Recorders (EDRs) Duration Study" dated 6/3/2020 under a cover letter signed by S. William Gouse, Director, Federal Programs, SAE International.

[12] At page 11, above Figure 7 in Chen, R.J., Tatem, W.M., & Gabler, H.C. (2017) Event data recorder duration study (Appendix to a Report to Congress. Report No. DOT HS 813 082B). National Highway Traffic Safety Administration; as reference 7 to the NPRM

[13] "Time Zero" is used here as defined in 49CFR563.5.

[14] At page 1, item 2 "Approach" in Chen, R.J., Tatem, W.M., & Gabler, H.C. (2017) Event data recorder duration study (Appendix to a Report to Congress. Report No. DOT HS 813 082B). National Highway Traffic Safety Administration; as reference 7 to the NPRM

[15] At page 2, item 2 "Phase 1" of Chen, R.J., Tatem, W.M., & Gabler, H.C. (2017) Event data recorder duration study (Appendix to a Report to Congress. Report No. DOT HS 813 082B). National Highway Traffic Safety Administration; as reference 7 to the NPRM; the authors refer to the NASS/CDS data for 2000-2015.

[16] ASCM coverage was introduced in the Bosch CDR Tool starting with version 19.1 (release date Sept 2019) were the appropriate "direct-to-module" cables were identified and then actual vehicle specific coverage was introduced in version 19.2 (release date 12/2019) where 20 identified Buick, Cadillac, Chevrolet and GMC models were identified as supported for ASCM data retrieval.

[17] Given the capability to retrieve ASCM data began with version 19.2 of the Bosch CDR Tool released in December 2019, the search was limited to investigation year 2020. There is no search option for any year after 2020 in the CISS search function.

[18] Insurance Institute for Highway Safety, IIHS Moderate Overlap Front Test CEF 1803.

[19] Here "time zero" (lower case) is not to be confused with "Time Zero" as defined in 49CFR563.5 and used in the regulation.

[20] The timing seen in the EDR data corresponds to the IIHS in-car video of the test.

[21] Also referred to as an External Object Calculation module (EOCM).

[22] Inasmuch as this system is independent of the ARC and its EDR functionality, one cannot assume that the "time zero" (lower case) for the ASCM is the same as the "Time Zero" as defined in 49CFR563.5 and used, in whatever manner, in recorded EDR data.

[23] In one example the "AEB Object Time to Collision (Sec)" data value at -3.92 sec was 4.35 sec and in another it was 5.075 sec.

[24] Pun intended.

[25] Here, as used in 49CFR563.