GENERAL MOTORS NORTH AMERICA
Structure & Safety Integration

June 11, 2004

Kathleen C. DeMeter, Director
Office of Defects Investigation
NHTSA Enforcement
Room #5328
400 Seventh Street, S.W.
Washington, D.C. 20590

GM-650

NVS-213 phk
PE03-059

Dear Ms. DeMeter:

There were questions that arose during the meeting between General Motors and NHTSA on June 3, 2004, that we agreed to follow-up on. Our answers to these questions were provided to Jeffrey Quandt during a conference call discussion on June 8, 2004. This letter contains General Motors (GM) written response to those same questions.

Your questions and our corresponding replies are as follows:

1. **Has GM conducted any safety recalls in the past 20 years for engine stalling?**

   Since 1993, GM has conducted three (3) safety recalls for issues that involve vehicle stalling, including one recently for the 2002 model year Oldsmobile Bravada and GMC Envoy vehicles equipped with Electronically Controlled Air Springs (ECAS) (reference attachment 1). Information prior to 1993 is not readily available.

2. **How many Special Policy and Customer Satisfaction Campaigns has GM conducted in the past 20 years for engine stalling?**

   Since 1993, GM has conducted seventeen (17) field actions involving vehicle stalling, including eight (8) Emission campaigns, five (5) Customer Satisfaction campaigns, and four (4) Special Policy campaigns (reference attachment 1). Information prior to 1993 is not readily available.

3. **Relative to the Saab 210 HP aborted take-off stall, can an aborted take-off stall occur with the vehicle moving? If so, under what circumstances?**

   An engine stall may occur when the vehicle is moving at a speed below which the vehicle will not "drive" the engine (i.e. engine rpm is not "driven" above idle speed of 650 rpm). While the precise speed will vary depending on the vehicle configuration, the threshold is generally considered to be approximately five (5) miles per hour.

4. **How would GM reconcile its demonstration of the aborted take-off stall with customer reports that indicated the vehicle traveled more than five (5) feet?**

   It is possible for the vehicle to travel more than five (5) feet before coming to rest after executing an aborted take-off maneuver, depending on the road conditions and the driver's actions. The total distance includes the distance traveled prior to the driver's decision to "abort", plus the distance driven until the point of brake apply. The total distance is also a function of; the maximum speed achieved during the acceleration period, the driver's braking inputs, and the road grade.

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An analysis of a recorded stall event on a 2003 production vehicle, with the subject condition, and the data obtained from the 2003 vehicle with modified software used in the MPG stall video work, were used to provide the following estimates for the maximum speeds achieved and distances traveled:

Aborted Take-off Starting At zero (0) miles per hour:

Vehicle	Maximum Speed	Distance - start to aborted take-off	Distance to brake apply	Total distance traveled
2003 Production	2.0	2'	4.1"	6.1'
2003 Modified Software	5.3	3.3'	1.8'	5.1'

Aborted Take-off Maneuver Starting At five (5) miles per hour:

Vehicle	Maximum Speed	Distance - start to aborted take-off	Distance to brake apply	Total distance traveled
2003 Production	7.0	8.2'	*	Est. 10.6' ++
2003 Modified Software	10.3	9.5'	*	Est. 13.8' ++

++ Dependent on driver braking and road grade, based on 2003 Modified Software scenario reaction braking time.
+ No brake apply
* No recorded data, without braking available for this maneuver

5. **Relative to Saab 210 HP aborted take-off stall condition, how close is the simulated vehicle operation and resulting aborted-stall to the "competing governor" operation stated in the subject Information Responses?**

The end effect of an engine stall and resulting vehicle operation for the simulated event (2003 Modified Software) is consistent with what is actually occurring in the field.

The primary differences are that the duration and amplitude of the engine oscillations for the simulated video event are lower. For the stall video (2003 Modified Software), the engine was "manually" stalled after allowing the engine to oscillate for a short duration. While the amplitude of this oscillation was reduced due to warm engine operation, the duration was simulated to more closely reflect the timing of the stall.

In an effort to ensure a more repeatable stall event, software changes were incorporated for the NHTSA demonstration by raising the engine cut-off speed from 300 to 600 rpm. The effect was that the engine stalled on the first oscillation, rather than after several oscillations, as observed in the 2003 Production vehicle with the subject stalling condition.

6. **Is EDR data available for the one automatic Saab crash incident? If so, does the data available from the EDR match the reported description of the event?**

The Event Data Recorder (EDR) from the subject vehicle was not interrogated after the crash event. If GM and Saab feel it is necessary to retrieve the EDR data, the required hardware and software can be sent from Sweden because U.S. Saab dealers do not have this capability. Documents that describe the event indicate that the air bags deployed during the crash. Normal repair procedures require replacement of the EDR after an air bag deployment event. Therefore, this data may no longer be available.

7. **Has GM contacted any Saab customers that allegedly experienced an engine stall?**

GM is not aware of any additional customer contacts beyond those documented through the Saab Customer Assistance Center.

8. Will GM provide a copy of the June 3, 2004 presentation material on Engine Stall?

GM is providing a copy of the presentation in attachment 2.

Sincerely,

Gay P. Kent
Director
Product Investigations

Attachment 1

1563	Customer Satisfaction	93067			504,202	1992-1993	Cavalier Corsica Beretta Cutlass Ciera Century	Intake Manifold Gasket (2.2L)	12/16/1
1731	Customer Satisfaction	96-C-33			608	1996	K-Pickups C/K Suburbans	Kinked Trans. Auxil. Oil Cooler Inlet Line	06/13/1
1732	Customer Satisfaction	96-C-35			41,908	1996	CKPG	Upper Intake Manifold Gasket Failure	07/18/1
1824	Customer Satisfaction	98024			94	1999	W3500 W4500 W5500	Fuel Injection Pump Replacement W/4HE1-TC Engine	04/16/1
1984	Customer Satisfaction	00101			59,192	2000-2001	Cavalier Malibu Alero Sunfire Grand Am	Erratic Fuel Gauge Reading	01/18/2
E270	Emission	94093			31,443	1995	Bonneville Eighty-Eight Ninety-Eight Park Avenue Riviera	Powertrain Control Module IAC Algorithm Error	12/21/19
E277	Emission	95-C-31			157,855	1995	S10 Blazer Sonoma Jimmy	Crankshaft Position Sensor Failures	04/28/19
E286	Emission	97040			9,707	1997	Corvette	Calibration Reflash	08/15/19
E301	Emission	98007			677,518	1996-1998	C/K & ML Trucks	Ignition Coil Wire Arcing	03/12/19
E302	Emission	98008			110,000	1998	Trans Sport Venture Silhouette	Relocation of Evaporative Emission Vent Solenoid Valve Assembly	02/09/19
E323	Emission	99065			264,439	1995-1996	Cavalier Sunfire	PCM Corrosion/Moisture Intrusion	03/14/20
E324	Emission	99090			695,790	1995-1999	Cavalier Sunfire	PCM Corrosion/Moisture Intrusion	05/05/20
E339	Emission	04016			157	2003	Silverado Express Sierra Savana	Alternative Fuel PCM Software Anomalies	01/15/20

S57	Special Policy	99067			890,708	1992-1994	S/T, M/L & C Trucks	Linear Exhaust Gas Recirculation System	02/21/1
S63	Special Policy	99068			585,241	1995	S/T & M/L Trucks	Linear Exhaust Gas Recirculation System	02/12/1
S77	Special Policy	00096			154,399	1996-1997	Camaro Firebird Impala Caprice Roadmaster Fleetwood	EGR Valve Failure	01/19/2
S86	Special Policy	03019			258,784	2002	TrailBlazer Envoy Bravada	Cylinder Bore Liner Cracks	06/06/20
2132	Safety	04014	04V-110	GM647	93,572	1995-1997	Aurora	Premium V8 Nylon 12 Fuel Rail	05/26/20
2132A	Safety	04014A	04V-110A		406,363	1995-1997	Eldorado Seville Deville	Premium V8 Nylon 12 Fuel Rail	
2150	Safety	04048			32,972	2002	Bravada Envoy	PCM Disruption Induced Vehicle Stall	

Attachment 2

Engine Stall

June 3, 2004

GM and NHTSA

AGENDA

- Unreasonable Risk: NHTSA's perspective on engine stall
- GM's Design Philosophy & Practices
- GM's current perspective on engine stall
- Saab 9-3
- Next Steps

Unreasonable Risk

- How does NHTSA define unreasonable risk to safety?

NHTSA Perspective - Engine Stalling

GM's Design Philosophy & Practices

- Utilizes DFMEA approach.
- Engine stall occurring on vehicle deceleration is not necessarily a safety related defect.
- Engine stalls occurring on acceleration require more rigorous review.
- ~45 service bulletins per model year.
- Principles of design:
  - Complexity of what can cause engine stalling
  - Redundancy of design. Mechanical back-up and failsafe.
  - Learning algorithms
  - OnStar

Vehicle Causes of Engine Stalls

- Fuel Delivery
- Spark Delivery
- Air Delivery
- Potential Failure Mechanisms:
  - Hardware
  - Software
  - Capability

Stall Prevention Measures

Fuel Delivery:

- Fuel trim
- IFRD
- Fuel Integrators
- Canister Purge System

Spark Delivery:

- Misfire diagnostics

Stall Prevention Measures

Airflow Delivery:

- Electronic Throttle Control Diagnostics
- Closed-loop rpm control
- Minimum commanded RPM
- Compensation for anticipated engine loads
- RPM control algorithm
- Backup sensor
- Stall saver feature
- Minimum airflow calibrations
- Canister purge system

Evaluating Stall Conditions

- Integrated and data driven approach to evaluating an engine stall condition, including customer feedback
- GM Approach evaluates both observed and predicted:
  - Severity - potential effects of stall
  - Incident Rate - likelihood of occurrence
  - Warning - driver detection
- Other factors, beyond the design and manufacture of vehicles, can cause stalling:
  - Vehicle maintenance
  - Fuel quality
  - Out of fuel
  - Environmental extremes

Severity – Potential Effects Of Stall

- Severity assessment facilitated by how well the root cause(s) is understood
- Proper root cause permits
  - The identification of the conditions required for stall
  - An assessment of when the stall is likely to occur
    - During specific maneuvers (e.g. steering)
    - At specific intervals of vehicle operation (e.g. warm-up)
    - Potential Consequences - potential for crashes & injuries
  - Effect on vehicle performance/controllability
    - Reduced steering assist
    - Brake assist reserve
  - Ability to restart

Incident Rate

- Predicted Rates
- Actual/Observed Rates
  - Accounting for field exposure
- Relative Occurrence
- Peer Vehicles
- Exposure Period
- Useful life (single/multiple causes)

Warning – Driver Detection

- Warnings that the engine may stall prior to its occurrence:
  - Sensory (e.g. rough idle, engine oscillation, vehicle speed, performance deterioration over time)
  - Audible (e.g. chime)
  - Visual (e.g. indicator/telltale light, tachometer)

Saab 9-3 Engine Stall Conditions

- 175 HP: only during decel, coming to a stop
- 210 HP: driver initiated aborted take-off, est. vehicle moves 5 feet prior to stall, based on MPG simulation and analysis
- Resulting vehicle performance:
  - Steering control maintained and demonstrated to NHTSA on 5/17
  - No degradation of brake performance following a stall. At least 4 brake applies with full power assist.
  - Vehicle can be restarted immediately
  - Data collected and vehicle maneuvers filmed using a 5% female driver.
- GM initiated a Customer Satisfaction program in February 2004. Completion rate 70% on June 11th.

SAAB Severity Evaluation

- Root cause for both the aborted take-off and decel stall issues is well understood
- The conditions necessary for a stall event for both issues are well understood
  - Aborted take-off stalls occur within a very narrow window of vehicle operation and could be considered unlikely to involve significant risk
  - Decel stalls occur within a window of vehicle operation that is unlikely to involve significant risk
  - Controllability and brake reserve demonstrated, with data, using a 5th percentile female driver
- 100% restart capability
- To date, no crashes or injuries are the result of either condition

Next Steps.....

- Conclusions and Recommendations
- Develop and carry out research to determine the relative contribution of vehicle stalling to accidents, injuries, and deaths versus other accident causes.
  - Getting a common understanding would likely help NHTSA and industry to reach consensus on stalling issues and unreasonable risk.
  - Update the Technical Report on Analysis of Stalling Problems, by Simon Prensky, June 1987.
- Allow the auto manufacturer to, when appropriate, "treat symptoms" in addressing engine stalls through future advances in rulemaking to enable usage of e.g. OnStar to download software "updates"