

TOYOTA

TOYOTA MOTOR NORTH AMERICA, INC.

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OFFICE OF DEFECTS &
INVESTIGATIONS

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2011 MAY -2 P 2: 23

April 29, 2011

Mr. Jeffrey L. Quandt, Chief
Vehicle Control Division
Office of Defects Investigation
National Highway Traffic Safety Administration
1200 New Jersey Avenue, SE
Washington, DC 20590

Re: NVS-213krh; PE11-005

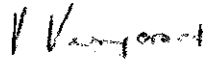
Dear Mr. Quandt:

On behalf of Toyota Motor Corporation, this is a partial response to your March 1, 2011 information request (IR) regarding PE11-005. Enclosed you will find two copies of Toyota's responses to questions 1-8(a), 9-11, and 13-18, along with several attachments. You previously granted Toyota an extension of time until May 20, 2011 to respond to Questions 8(b), 8(c), and 12.

Please be aware that several of the attachments provided with this response contain confidential and proprietary business information. Therefore, Toyota is submitting a request to NHTSA's Office of Chief Counsel for a determination that those materials are entitled to confidential treatment pursuant to 49 CFR Part 512 and Exemption 4 of the Freedom of Information Act, 5 U.S.C. § 552(b)(4).

Should you have any questions about this response, please contact me at (202) 775-1707.

Sincerely,



Vinnie Venugopal, General Manager
Toyota Motor Engineering & Manufacturing
North America, Inc.

VV:mh
Enclosure

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OFFICE OF DEFECTS &
INVESTIGATIONS

1. State, by model and model year, the number of subject vehicles Toyota has manufactured for sale or lease in the United States and federalized territories. Separately, for each subject vehicle manufactured to date by Toyota, state the following:

- a. Vehicle identification number (VIN);
- b. Model;
- c. Model Year;
- d. Date of manufacture;
- e. Date warranty coverage commenced; and
- f. The State in the United States, or the federalized territory, where the vehicle was originally sold or leased (or delivered for sale or lease).

Provide the table in Microsoft Access 2003, 2007, or a compatible format, entitled "PRODUCTION DATA."

Response 1

The number of MY 2006 Toyota Highlander HV vehicles manufactured for sale or lease in the United States is 43,931.

In addition, the detailed information responsive to "a" through "f" is provided electronically on CD-ROM in Microsoft Access 2000 format entitled "PRODUCTION DATA (PE11-005).mdb" stored in the folder "Attachment-Response 1."

2. State, by model and model year, the number of subject vehicles Toyota has manufactured for sale or lease in the United States and federalized territories for which Toyota has sold an extended service plan. For vehicles with more than one extended service plan, list the vehicle separately for each plan. Separately, for each vehicle, state the following:

- a. Vehicle Identification Number (VIN);
- b. Model;
- c. Model Year;
- d. Name of extended service plan;
- e. Mileage at which the extended service plan expires; and
- f. Number of months from the warranty start date at which the extended service plan expires.

Provide the table in Microsoft Access 2003, 2007, or a compatible format, entitled "SERVICE PLAN DATA."

Response 2

The number of the subject vehicles for which Toyota sold an extended service plan is provided, by model and model year, as "Attachment-Response 2". Please note that this "Attachment- Response 2" contains trade secret and commercial information, therefore, Toyota believes that this document must be afforded confidential treatment. A request for confidential treatment of this document has been sent to the Office of Chief Counsel. A public version of this document is included with this response.

In addition, the detailed information responsive to "a" through "f" is provided electronically on CD-ROM in Microsoft Access 2007 format entitled "SERVICE PLAN DATA (PE11-005).accdb" stored in the folder "Attachment-Response 2."

3. State the number of each of the following, received by Toyota, or of which Toyota is otherwise aware, which relate to, or may relate to, the alleged defect in the subject vehicles:
 - a. Consumer complaint, including those from fleet operators;
 - b. Field reports, including dealer field reports;
 - c. Reports involving a crash, injury, or fatality based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in the subject vehicle, property damage claims, consumer complaints, or field reports;
 - d. Reports involving a fire, based on claims against the manufacturer involving a death or injury, notices received by the manufacturer alleging or proving that a death or injury was caused by a possible defect in a subject vehicle, property damage claims, consumer complaints, or field reports;
 - e. Property damage claims;
 - f. Third-party arbitration proceedings where Toyota is or was a party to the arbitration; and
 - g. Lawsuits, both pending and closed, in which Toyota is or was a defendant or codefendant.

For subparts "a" through "e," state the total number of each item (e.g., consumer complaints, field reports, etc.) separately. Multiple incidents involving the same vehicle are to be counted separately. Multiple reports of the same incident are also to be counted separately (i.e., a consumer complaint and a field report involving the same incident in which a crash occurred are to be counted as a crash report, a field, and a consumer complaint).

In addition, for items "c" through "g," provide a summary description of the alleged problem and causal and contributing factors and Toyota's assessment of the problem, with a summary of the significant underlying facts and evidence. For items "f" and "g," identify the parties to the action, as well as the caption, court, docket number, and date on which the complaint or other document initiating the action was filed.

Response 3

For purposes of identifying reports of incidents which relate to, or may relate to, the alleged defect on the subject components, Toyota used the following categorizations in the review of each report for items "a" through "g".

Category	Description
A1	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in stall/limp while driving (confirmed through recovered parts analysis)
A2	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in no start, no movement, or no "Ready On" from stopped position (confirmed through recovered parts analysis)
A3	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in MIL light on only (confirmed through recovered parts analysis)
AA1	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in stall/limp while driving (presumed but unconfirmed)
AA2	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in no start, no movement, or no "Ready On" from stopped position (presumed but unconfirmed)
AA3	Inverter Insulated-Gate Bipolar Transistor (IGBT) problem resulting in MIL light on only (presumed but unconfirmed)
I1	Other inverter problem resulting in stall/limp while driving
I2	Other inverter problem resulting in no start, no movement, or no "Ready On" from stopped position
I3	Other inverter problem resulting in MIL light on only
B1	Supporting component problem resulting in stall/limp while driving
B2	Supporting component problem resulting in no start, no movement, or no "Ready On" from stopped position
B3	Supporting component problem resulting in MIL light on only
C1	Stall/limp failures with unclear cause
C2	No start, no movement, or no "Ready On" failures from stopped position with unclear cause
C3	MIL light on with unclear cause

Toyota is providing reports of incidents categorized as "A", "AA", "I", and "B" in response to the request for reports which relate to, or may relate to, the alleged defect on the subject components. Reports of incidents categorized as "C" are not responsive due to the ambiguity, or lack of, the information available to support a determination that these reports relate to the alleged defect on the subject components.

Additionally, Toyota is now providing Technical Assistance System (TAS) call reports as "dealer reports" which relate to, or may relate to, the alleged defect on the subject components. Toyota began providing

these reports as part of the quarterly EWR data submission in late 2010 and understands that these TAS reports may be deemed as responsive to this request.

Using the methodology described above, the number of reports which are responsive to this request are provided electronically on CD-ROM in Microsoft Excel 2003 format entitled "Total Count for Reports.xls" stored in the folder "Attachment- Response 3." Due to the broad scope of the definition of alleged defect in this information request, included are reports that do not exactly mention engine stall or loss of power, such as no start, movement, or "MIL ON" only conditions.

For items "c" through "g", a summary description is also provided in "Total Count for Reports.xls." There are no crash or injury cases related to the alleged defect.

4. Separately, for each item (complaint, report, claim, notice, or matter) within the scope of your response to Request No. 3, state the following information:
 - a. Toyota's file number or other identifier used;
 - b. The category of the item, as identified in Request No. 3 (i.e., consumer complaint, field report, etc.);
 - c. Vehicle owner or fleet name (and fleet contact person), address, and telephone number;
 - d. Vehicle's VIN;
 - e. Vehicle's model and model year;
 - f. Vehicle's mileage at time of incident;
 - g. Incident date;
 - h. Report or claim date;
 - i. Whether a crash is alleged;
 - j. Whether a fire is alleged;
 - k. Whether a property damage is alleged;
 - l. Number of alleged injuries, if any; and
 - m. Number of alleged fatalities, if any.

Provide this information in Microsoft Access 2003 or 2007, or a compatible format, entitled "REQUEST NUMBER THREE DATA."

Response 4

The information "a" through "m" for each item (complaint, report, TAS case, matter) is provided electronically on CD-ROM in Microsoft Access 2003 or 2007 format entitled "REQUEST NUMBER THREE DATA (PE11-005).mdb" stored in the folder "Attachment-Response 4". In addition, Toyota is providing information pertaining to the individual categories described in the previous response for each item listed in the attachment.

5. Produce copies of all documents related to each item within the scope of Request No. 3. Organize the documents separately by category (i.e., consumer complaints, field reports, etc.) and describe the method Toyota used for organizing the documents.

Response 5

Lists of the consumer complaints, TAS calls, the copies of field reports, and the documents related to the third-party arbitration case are all provided electronically on CD-ROM in Microsoft Excel 2003 or 2007, or PDF format stored in the folder "Attachment-Response 5." (The list of consumer complaints is stored in the sub-folder "Consumer Complaint." The list of TAS call records is stored in the sub folder "TAS." The copies of the field reports are stored in sub-folder "Field Report." The copies of the documents for the third-party arbitration case are stored in the sub-folder "Arbitration."

6. State, by model and model year, a total count for all of the following categories of claims, collectively, that have been paid by Toyota to date that relate to, or may relate to, the alleged defect in the subject vehicles: warranty claims; extended warranty claims; claims for good will services that were provided; field, zone, or similar adjustments and reimbursements; and warranty claims or repairs made in accordance with a procedure specified in a technical service bulletin or customer satisfaction campaign. Separately, for each such claim, state the following information:
 - a. Toyota's claim number and total cost per claim;
 - b. Vehicle owner or fleet name (and fleet contact person) and telephone number;
 - c. VIN;
 - d. Repair date;
 - e. Vehicle mileage at time of repair;
 - f. Repairing dealer's or facility's name, telephone number, city and state or ZIP code;
 - g. Labor operation number;
 - h. Problem code;
 - i. Replacement part number(s) and description(s);
 - j. Concern stated by customer;
 - k. Cause and Correction stated by dealer/technician; and
 - l. Additional comments, if any, by dealer/technician relating to claim and/or repair.

Provide this information in Microsoft Access 2003 or 2007, or a compatible format, entitled "WARRANTY DATA."

Describe in detail the search criteria used by Toyota to identify the claims identified in response to Request No. 6, including the labor operations, problem codes, part numbers and any other pertinent parameters used. Provide a list of all labor operations, labor operation descriptions, problem codes, and problem code descriptions applicable to the alleged defect in the subject vehicles. State, by make and model year, the

terms of the new vehicle warranty coverage offered by Toyota on the subject vehicles (i.e., the number of months and mileage for which coverage is provided and the vehicle systems that are covered). Describe any extended warranty coverage option(s) that Toyota offered for the subject vehicles and state by option, model, and model year, the number of vehicles that are covered under each such extended warranty. Describe any extended warranty coverage option(s) that Ford offered for the subject vehicles.

Response 6

The total count of warranty claims, extended warranty claims, and claims for good will services paid by Toyota for the subject vehicles that relate to, or may relate to, the alleged defect on the subject components are provided electronically on CD-ROM in Microsoft Excel 2003 format entitled "Total Count for Claims.xls" stored in the folder "Attachment-Response 6". The detailed information for each claim is also provided electronically on CD-ROM in Microsoft Access 2007 format entitled "WARRANTY DATA (PE11-005).mdb" stored in the folder "Attachment-Response 6."

The search criteria used by Toyota to identify the claims is the following:

Toyota searched the warranty database for those claims that replaced any of the parts identified in the Microsoft Excel file entitled "Search Criteria, Operation & Problem Codes.xls" stored in the folder "Attachment-Response 6" on CD-ROM. Each warranty claim condition, cause, and remedy description was then reviewed and determined to be responsive under similar guidelines to those set forth in Response No. 3.

A list of all labor operations, labor operation description, problem codes and problem code descriptions identified in these warranty claims are also provided in the same Microsoft Excel file described above.

The terms that Toyota offers for new vehicle warranty coverage on MY 2006 Highlander Hybrid Vehicles are as follows:

For the Hybrid inverter and THS ECU

96 months or 100,000 miles from the vehicle's date-of-first-use, whichever occurs first.

For the inverter system related components (water pump)

60 months or 60,000 miles from the vehicle's date-of-first-use, whichever occurs first.

For the inverter system related components (reservoir tank, radiator)

36 months or 36,000 miles from the vehicle's date-of-first-use, whichever occurs first.

There are some extended warranty coverage options that Toyota offered for purchase with the subject vehicles. Detailed information about these options is provided electronically on CD-ROM, in PDF format,

entitled "Extended Warranty Option.pdf" stored in the folder "Attachment-Response 6."

The number of vehicles that are covered under each such extended warranty option, by option, model, and model year have been provided in Response No. 2 with a request that the information be afforded confidential treatment, because it contains trade secret and commercial information.

7. Produce copies of all service, warranty, and other documents that relate to, or may relate to, the alleged defect in the subject vehicles, that Toyota has issued to any dealers, regional or zone offices, field offices, fleet purchasers, or other entities. This includes, but is not limited to, bulletins, advisories, informational documents, training documents, or other documents or communications, with the exception of standard shop manuals. Also include the latest draft copy of any communication that Toyota is planning to issue within the next 120 days.

Response 7

Toyota has not issued any additional service bulletins concerning the alleged defect other than the service bulletin TSB 0386-08 mentioned in the subject of this request. The subject service bulletin TSB 0386-08 is being provided in PDF format as "Attachment-Response 7.pdf".

8. Provide the following information regarding the subject bulletin:

- a. A chronology of events related to the issuance of the bulletin, including a detailed description of when and how Toyota first recognized the concerns described in the bulletins, what actions were taken to investigate the concern and all meetings conducted to review the concerns and make the decision to issue the bulletins and each revision thereof;
- b. All 8-D reports or any equivalent technical investigations and final reports associated with TSB-0386-08; and
- c. Copies of all documents related to investigation and review of the concerns addressed by the subject bulletins, including all material presented at all meetings conducted to review the investigation and analysis of field data (e.g., complaints, field reports, and warranty data), the development of the correction, predicted failure rates, and the potential safety consequences.

Response 8

a. Toyota shows the chronology of events related to the issuance of the subject bulletin below.

May 2007: Toyota received a field technical report from the Japan market indicating that the engine had stopped when the customer started moving from a stop. This report was received on a Harrier HV vehicle (US name: RX400h).

Aug. 2007: As a result of the investigation of the recovered inverter assembly from the Harrier HV vehicle, it was found that the IGBT (Insulated Gate Bipolar Transistor) inside the inverter assembly was damaged.

Toyota received a second field technical report on another Harrier HV vehicle from the Japan market indicating that the vehicle could not be driven even though the hybrid system turned on to READY mode. In addition, a dealer product report was received on a 2006MY RX400h vehicle from the US market indicating that the vehicle lost power and the hybrid warning light came ON.

- Sep. 2007-Nov. 2008: Relevant divisions of Toyota met on several occasions to investigate the issue. "Attachment-Response 8" identifies the meetings that Toyota had during that period.
- Sep. 2007: A field technical report was received from the US market indicating that the vehicle would not start and the master warning light came ON. The subject vehicle was a 2006MY Highlander HV vehicle.
- Dec. 2007: As a result of an analysis of IGBTs surrounding the damaged IGBT in one of the vehicles that had experienced a problem, Toyota found that the heat release performance of the solder for the IGBTs had deteriorated. Toyota presumed that this deterioration of heat dissipation performance caused overheating and eventually damaged the IGBT. It was also found that cracks in the cross-section surface of the solder may have contributed to the deterioration of heat dissipation. Toyota continued duplication tests and process checks to investigate the cause and extent of the IGBT failures.
- Feb. 2008: Toyota changed the inspection standard (i.e., the acceptance criterion) for the void ratio in the IGBT solder from 2% to 1.72% in order to enhance the heat release efficiency of the solder. Testing and analysis continued.
- Sep. 2008: Toyota confirmed that, with a void ratio of 1.72% and below, the IGBT damage does not occur even though the void converges on the center of the solder area.
- Dec. 2008: Toyota confirmed that, in case of an IGBT breakage and resulting inverter failure, the affected vehicle can be driven for some time in a fail-safe mode, although the distance is affected by the state of charge (SOC) of the HV battery at the time of the failure.
- Dec. 2008: Toyota informed its distributors of the problem as it was understood at that time, the countermeasure, and the affected vehicle population. Thereafter, the US distributor (TMS) issued the subject TSB to each dealer in the US.

For parts b-c, Toyota will provide copies of all documents related to its investigation and to the subject bulletins in supplemental submissions by May 20.

9. Describe all modifications or changes made by, or on behalf of, Toyota in the design, material composition, manufacture, quality control, supply, or installation of the subject component, from the start of production to date, which relate to, or may relate to, the alleged defect in the subject vehicles. For each such modification or change, provide the following information:

- a. The date or approximate date on which the modification or change was incorporated into vehicle production;

- b. A detailed description of the modification or change;
- c. The reason(s) for the modification or change;
- d. The part number(s) (service and engineering) of the original component;
- e. The part number(s) (service and engineering) of the modified component;
- f. Whether the original unmodified component was withdrawn from production and/or sale, and if so, when;
- g. When the modified component was made available as a service component; and

Also, provide the above information for any modification or change that Toyota is aware of which may be incorporated into vehicle production within the next 120 days.

Response 9

Toyota has summarized in a table all modifications or changes made by Toyota, or on behalf of Toyota in the design, material composition, manufacture, quality control, supply, or installation of the subject component, which relate to, or may relate to, the alleged defect in the subject vehicles. We are providing this information as "Attachment-Response 9." Please note that some of the information included in the "Attachment-Response 9" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. A public version of "Attachment-Response 9" is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 9." Please see the Office of Chief Counsel for the confidential version of this document.

10. Produce the following:

- a. One sample of a new inverter/converter assembly; and
- b. One field return sample of the subject component exhibiting the subject failure mode.

Response 10

Samples will be provided separately.

11. Provide a graphical overview of the Toyota highlander hybrid propulsion system detailing gasoline and electric motor engagement relative to vehicle speed, acceleration, and battery state of charge (SOC). Describe electric motor failure modes effect on overall vehicle propulsion systems. Also describe the effect of engine limp or corresponding modes on overall vehicle propulsion systems.

Response 11

Toyota provides the appropriate pages of the New Car Features (NCF) for descriptions of the Toyota Highlander Hybrid propulsion system as "Attachment-Response 11-1."

The hybrid system of the Toyota Highlander Hybrid is mainly composed of the HV Battery, THS ECU, Inverter Assembly, and Hybrid Transaxle as described in the Attachment-Response 11-1. In this system, if the THS ECU detects a malfunction, the ECU performs a diagnosis and memorizes failed sections. Furthermore, to inform the driver of the malfunction, the ECU illuminates or blinks the MIL (Malfunction Indicator Lamp), master warning light, or HV battery warning light, which pertains to the ECU. The THS ECU will restore the respective DTCs of the malfunctions. In specific cases, depending on the malfunctions, the vehicle will go into "fail-safe" mode in addition to the warning lights. Because the hybrid system consists of two drive modes operated by either the electric motor or the gas engine/generator, if a malfunction occurs affecting one mode the other mode remains active to continue vehicle propulsion under limited mobility. Vehicle speed may be maintained due to vehicle momentum; however acceleration is limited due to the active operation of only either the electric motor or the gas engine/generator. Steering power assist and brake functions function normally during this state of "fail-safe" mode drivability. Depending on the hybrid battery state of charge (SOC), the vehicle may be driven for an extended period of time. When the vehicle nears the limit for additional drive capacity, the vehicle will slowly decelerate at a steady pace to the point of stopping completely. At this point, depending on the type of circuit failure, the vehicle will not enter Ready On mode or will not move forward from rest position.

Please see "Attachment-Response 11-2."

Please note that some of the information included in the "Attachment-Response 11-2" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. A public version of "Attachment-Response 11-2" is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 11." Please see the Office of Chief Counsel for the confidential version of this document.

12. For MY2006 inverter and converter integrated system architecture, provide the following:

- a. Toyota complete system specification requirements document;
- b. Supplier system specification requirements and software requirements documents;
- c. Toyota system vehicle test requirements document;
- d. Supplier system test requirements document;
- e. System DRBFM and fault tree for inverter/converter in PDF or Microsoft excel;
- f. System DRBFM and fault tree for inverter/converter for MY2009 if modified from MY2006; and
- g. System DV and PV test plan, DV/PV test matrix and final DV and PV test report for MY 2006.

Response 12

Toyota will provide information or documents related to this response in supplemental submissions by May 20

13. Provide complete hardware architecture and complete PDF schematics for the inverter/converter system.

List and briefly describe all software diagnostics routines performed. Also provide the following:

- a. A Bill of Material (BOM) including part numbers, component description, component quantity in system, and supplier names for each and every component in the inverter/converter system; and
- b. List all silicon ICs including ASIC (application specific integrated circuits) in the system including part numbers and suppliers. Proprietary and non-proprietary IC specifications for all system power supplies and power regulators must be submitted.

Response 13

Toyota is providing the hardware architecture of the inverter assembly in "Attachment-Response 13-1." As for its schematics, please refer to the NCF that is provided as "Attachment-Response 11-1."

In the hybrid system of the MY 2006 Highlander HV, upon detection of a malfunction, the THS ECU will illuminate the warning light(s) and store the respective DTC of the malfunction. Toyota is providing the appropriate pages of the application form for OBD for the MY 2006 Highlander HV, which includes all DTCs for the inverter assembly and logic flowcharts for each DTC, in "Attachment-Response 13-2" and "Attachment-Response 13-3."

- a. A BOM of the inverter assembly is provided as "Attachment-Response 13-4."
- b. A list of all silicon IC's, which are used in the inverter assembly, and their respective specifications are provided as "Attachment-Response 13-5."

Please note that some of the information included in the "Attachment-Response 13-1" through "Attachment-Response 13-5" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. Each public version is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 13." Please see the Office of Chief Counsel for the confidential version of this document.

14. Describe in detail inverter/converter cooling architecture including cooling pump, cooling fluid, thermal exchanges, pump control...etc. List and detail all software fault diagnostics routines. Also provide the following:
 - a. Describe cooling fluid characteristics, selection criteria and ionization properties; and
 - b. Pump datasheet and specifications must be submitted.

Response 14

Toyota is providing the appropriate page of the New Car Features (NCF) for descriptions of the cooling system for the Inverter assembly as "Attachment-Response 14-1."

As mentioned in the response of No.13, if the THS ECU detects a malfunction of the HV system, it will

illuminate the warning light(s) and store the respective DTC of the malfunction. Attachment-Responses 13-2 and 13-3 provide information related to system DTC's and flowcharts for the hybrid cooling system malfunction.

- a. The cooling fluid used for the inverter assembly in the MY 2006 Highlander HV is the exact same as the one used for engine or hybrid inverters on other Toyota models. The fluid used is an ethylene-glycol water solution with corrosion inhibitors and colorant. Toyota selected this specific fluid for its long-life properties, the ability to withstand freezing in as low as minus 35 deg C temperatures, and the ability to prevent burning on the aluminum used for the cooling channel of the gas engine. The corrosion inhibitors added in the cooling fluid will ionize the solution when it is diluted in water.
- b. Toyota is providing the water pump specifications in "Attachment-Response 14-2."

Please note that some of the information included in the "Attachment-Response 14-2" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. A public version of "Attachment-Response 14-2" is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 14." Please see the Office of Chief Counsel for the confidential version of this document.

15. For the traction motor(s)/generator(s) control module, provide the following:

- a. A Bill of Material (BOM) including part numbers, component description, component quantity in system and supplier names for each and every component in the system;
- b. A hardware block diagram architecture and PDF schematics including IC function, part numbers and suppliers;
- c. List and briefly describe all diagnostics routines performed in the motor control module including diagnostics performed on the traction motor(s)/generator (s);
- d. Pertinent electric traction motor/generator datasheets; and
- e. Toyota system specification requirements document for motor/generator control module.

Response 15

In the hybrid system on the MY 2006 Highlander HV, the MG-ECU located inside the inverter assembly controls the inverter and boost converter in order to drive the motor and generator in accordance with the signals received from the THS ECU. Furthermore, the MG-ECU controls the DC-DC converter in accordance with the signals received from the THS ECU. In response to the above request, Toyota has interpreted the traction motor(s)/generator(s) control module as pertaining to the MG-ECU, and is providing the following information for the MG-ECU as responsive to the request. Although the THS ECU serves the function of sending torque requirements and other related signals to the MG-ECU as it relates to hybrid propulsion, at this time Toyota is not providing documents related to the THS ECU in response to this

request.

- a. Toyota is providing a BOM of the MG-ECU in "Attachment-Response 15-1."
- b. "Attachment-Response 11-1" and "Attachment-Response 13-1" also show the MG-ECU architecture and schematics. Furthermore, Toyota has provided the information related to all IC's inside the MG-ECU in "Attachment-Response 13-5."
- c. "Attachment-Response 13-2" and "Attachment-Response 13-3" include and provide responsive information for all DTC's related to MG-ECU malfunction.
- d. Toyota is providing "Attachment-Response 15-2" for the specifications of the motor and generator.
- e. The Toyota system specification requirements document for the MG-ECU is included in our response No12a. Toyota will provide it as a supplement.

Please note that some of the information included in the "Attachment-Response 15-1" and "Attachment-Response 15-2" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. Each public version is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 15." Please see the Office of Chief Counsel for the confidential version of this document.

16. Provide a synopsis comparing MY 2006 Toyota Highlander with MY 2006 Prius inverter/converter design, operating conditions, durability requirements and related test results.

Response 16

Toyota is providing the appropriate pages of the New Car Features (NCF) for descriptions of the 2004 model year Prius Hybrid system, which is the same as the 2006 model year, in "Attachment-Response 16-1."

The major difference in inverter/converter operating conditions between MY 2006 Highlander HV and MY 2006 Prius is provided as "Attachment-Response 16-2."

Please note that some of the information included in the "Attachment-Response 16-2" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. A public version of "Attachment-Response 16-2" is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 16." Please see the Office of Chief Counsel for the confidential version of this document.

17. Provide an overview of Toyota inverter/converter product development and launch process including procurement, validation points/gates and review, schedule and product launch.

Response 17

Toyota is providing an example of the inverter assembly development and launch process as "Attachment-Response 17."

Please note that some of the information included in the "Attachment-Response 17" is confidential, and a request for confidential treatment has been submitted to the Office of Chief Counsel. A public version of "Attachment-Response 17" is included with this response to your office, provided on CD-ROM stored in the folder "Attachment-Response 17." Please see the Office of Chief Counsel for the confidential version of this document.

18. Furnish Toyota's assessment of the alleged defect in the subject vehicle, including:

- a. The causal or contributory factor(s);
- b. The failure mechanism(s);
- c. The failure mode(s);
- d. The risk to motor vehicle safety that it poses;
- e. What warnings, if any, the operator and the other persons both inside and outside the vehicle would have that the alleged defect was occurring or subject component was malfunctioning.

Response 18

Assessment of Field Information and Customer Complaints

As a result of Toyota's analysis of the field technical information, customer complaints, warranty claims, and other related information related to the alleged defect, Toyota has found that the most common failure modes reported by customers consist of MIL on, no start or no movement, and vehicle "stalling" or "loss of power". Due to the broad scope of the definition of alleged defect in this information request, Toyota has included all field information related to the aforementioned failure modes; however, in the assessment of the alleged defect in the subject vehicle, Toyota will focus primarily on the "stall" or "loss of power" failure modes.

Causal or Contributory Factors

Toyota has found that 98% of the reports identify the hybrid inverter assembly as the causal component contributing to the subject failure mode. By analyzing the trouble code information, it was estimated that 84% of the inverter failures appear to be related to a failure of an Insulated Gate Bipolar Transistor (IGBT) on the electric motor-drive circuit or on the generator-drive circuit in the Intelligent Power Module (IPM). Investigation of the failed inverter assemblies that were recovered through FTRs, DPRs, TAS cases, and warranty claims confirmed that 85% of the recovered components had experienced an IGBT failure.

Based on the investigation results, Toyota believes that, due to certain voids in the solder applied to the underside of the IGBT, the solder may deteriorate over time as the IGBT undergoes continuous high-load power cycling under vehicle driving conditions. As the solder underneath the IGBT deteriorates, heat dissipation may worsen, and eventually the IGBT may overheat and become damaged.

Investigation is ongoing to find out the relationship between the void condition in the solder applied to the IGBT and its potential failure, as well as any additional factors that could cause a failure of the IGBT.

Failure Mechanism/Mode

Toyota has found that 41% of the analyzed reports indicate that there was an inverter and related component failure that reportedly led to a vehicle "stall" or "loss of power" while driving. Toyota has examined all available information related to each of these reports. Although the consumers are generally not specific regarding the details of failure phenomenon, by design, a failure of an inverter IGBT cannot immediately cause a complete loss of motive power; rather, as replicated in numerous duplication trials, such a failure will cause the vehicle to enter the "fail-safe" mode, which allows limited mobility.

When the IGBT on either the electric motor-drive circuit or the generator-drive circuit is damaged, four malfunction indicator/warning lamps are illuminated on the instrument panel, and the vehicle enters "fail-safe" mode. Simultaneously, a warning tone indicating a hybrid system malfunction and a "clunk" or "thud" noise may be heard if a sudden drop in engine or motor torque occurs.

Regardless of which circuit the IGBT failure occurs on, the other circuit remains active. The specific consequences of the failure will vary, but in both cases, there will be some continued vehicle propulsion with limited mobility and acceleration. Vehicle speed may initially be maintained due to vehicle momentum; however, acceleration is limited due to the active operation of only either the electric motor or the gas engine/generator. Steering power assist and brake functions will continue to function normally, allowing the driver to control the vehicle to a location away from other vehicle traffic.

Depending on the hybrid battery state of charge (SOC), the distance that the vehicle may be driven after a failure of one of the IGBTs can vary. Typically, the hybrid battery maintains an average of 60% SOC under normal driving, thus allowing the vehicle to travel an additional 1-3 miles with limited acceleration after the conversion to "fail-safe" mode. When the vehicle nears the limit for additional drive capacity, the vehicle will slowly decelerate at a steady pace to the point of stopping completely. When this happens, the vehicle will no longer move forward or backward when the accelerator pedal is applied.

Risk to Motor Vehicle Safety

In assessing the risk of motor vehicle safety as it relates to the alleged defect on the subject vehicles, Toyota believes the following:

- The Toyota Hybrid System consists of two propulsion systems: a gasoline engine/generator and an electric motor. The existence of both systems allow for the hybrid vehicle to continue driving under "fail-safe" mode conditions should either of the two systems fail. The conditions of this mode allow the driver to maintain mobility until the hybrid battery SOC is fully depleted or charged. Since there is also normal operation of the steering power assist and braking systems, the vehicle can be driven to a

safe location. In the event that the driver continues to drive the vehicle under these conditions until the hybrid battery is completely depleted or completely charged, the vehicle will steadily decelerate, and there is no sudden stoppage. For these reasons, although Toyota is continuing its investigation into these issues, at this point, Toyota believes that because the failure of an IGBT causes the vehicle to enter the "fail-safe" mode, rather than experience a complete loss of power, it does not create an unreasonable risk to motor vehicle safety.

- The Toyota Hybrid System has the ability to alert the driver that there is a problem with the hybrid system. At the time when the THS ECU detects a malfunction within the inverter system related to the IGBT failure, the "Check Engine", skid, ECB, and master warning light illuminate simultaneously. In addition to the master warning light illumination, a message appears on the information/odometer display that cycles between "Check Hybrid System", "Check VSC System", and "Check AWD System." Furthermore, a warning tone is emitted denoting a malfunction in the hybrid system.
- Toyota acknowledges that a number of reports from customers indicate a vehicle "stall" or complete "loss of power" of the subject vehicle. In rare cases, customers report a loss of steering power-assist and braking performance as well. Toyota has made efforts to follow-up with certain customers who have reported such a condition and submitted a complaint to either NHTSA or to our internal Customer Relations (CR) center. Based on these contacts, Toyota believes that these drivers did not pull over to a safe location but continued to drive in "fail-safe" mode until the vehicle slowly decelerated to the point where the vehicle could no longer be driven. By confirming this possible scenario in duplication trials, Toyota believes that the vehicle "stall" described by the customers does not come immediately after the IGBT failure, but rather at the end of the duration of "fail-safe" mode driving, after the vehicle has steadily decelerated to a stop.
- Toyota has also reviewed the consumer complaints provided in response to Question 4. Toyota observes that the vast majority (91%) of the consumers who reported an incident that involved stalling or "fail-safe" mode were also seeking reimbursement for the cost of the repair and/or related towing, rental, or hotel expenses.
- Finally, Toyota has searched all field reports, consumer complaints, TAS calls, legal matters, and warranty claims, and it has not identified any crashes or claims for injuries or property damage that relate to the alleged defect.
- Toyota has been investigating this issue and will continue its assessment, including how to address our customers' concerns.

* * *

Data provided in this document is current as of the following dates:

Response		Dates
Response 1	Production Data	3/16/2011
Response 2	Extended service plan data	3/24/2011
Response 3 - 5	Consumer Complaints	3/17/2011
	Field Reports	3/17/2011
	TAS Reports	4/06/2011
	Lawsuits	3/10/2011
Response 6	Warranty claims	3/10/2011
	Goodwill	3/17/2011
	Extended warranty claims	3/24/2011
Response 7	Dealer communications	3/22/2011
Response 9	Actions	3/22/2011

In the foregoing responses to this Information Request ("IR"), information has been obtained from those departments and employees knowledgeable about the subject matter of this inquiry most likely to have such information in the regular and ordinary course of business. When a particular Request seeks "documents" as defined in the IR, reasonable, good faith searches have been made of corporate records where such documents would ordinarily be expected to be found and to which Toyota would ordinarily refer when looking for such information.

The definitions of "documents" and "Toyota", however, are unreasonably broad, vague, and ambiguous, and Toyota objects to such definitions, because they exceed a reasonable understanding of such terms. For example, "calendars", "travel reports", "contracts" and "personnel records", to name a few, would not normally contain responsive information pertaining to the alleged defect subject of this inquiry. Toyota has also not provided information from electronic files that require extraordinary or expert means to retrieve that are generally unavailable to the computer user.

In addition, Toyota has not provided information from persons or entities over which it does not ordinarily exercise control, such as independent suppliers and contractors. Toyota also objects to the definition of "Toyota" to the extent it purports to include outside counsel. It would be unduly burdensome to require Toyota to request that outside counsel search files for responsive documents. Moreover, it is highly unlikely that outside counsel would possess any non-privileged documents responsive to this IR that are not already being produced by Toyota. In light of the significant burden and cost associated with canvassing outside counsel for potentially responsive documents and the very low probability of identifying any non-privileged document not already being produced, Toyota has not asked its outside counsel to search for responsive documents.

Toyota understands this IR to seek information on vehicles manufactured for sale in the United States and its territories. Also, we understand documents specifically related to the preparation of the responses are not sought.

The source of information used as a basis for the data in each Attachment, including the date the data were updated and retrieved, is identified above as applicable. If a document itself is the source for the requested information and it is provided, no further source identification is provided. If a document, drawing or component is requested, or if no responsive information is available, we assume no further source identification is called for.

Toyota is not providing privileged documents that may be responsive to this Information Request. With regard to claims of privilege, Toyota understands that it is acceptable to the Agency for Toyota to identify

specific categories of privileged documents rather than any specific document within those categories. These categories include: (a) communications between outside counsel and employee's of Toyota's Law Department, other Toyota employees, or employees of parties represented by Toyota in litigation and claims; (b) communications between employees of Toyota's Law Department and other Toyota employees, or employees of parties represented by Toyota in litigation and claims; (c) notes and other work product of outside counsel or of employees of Toyota's Law Department , including work product of employees or consultants done for or at the request of outside counsel or Toyota's law Department. For any privileged documents that are not included in these categories, if any, Toyota will provide a privilege log identifying any such document under separate cover. Toyota is not claiming a legal privilege for any documents provided with this response; however, Toyota does not waive the legal privilege or work-product protection with respect to other documents that may have been prepared in connection with a specific litigation or claim. In addition, Toyota may assert the attorney-client privilege or claim protection under the work-product protection for analyses or other documents that may be prepared in connection with litigation or claims in the future.

Toyota understands that NHTSA will protect any private information about persons that is contained in the Attachments to this response, based on privacy considerations. Such private information includes data such as names, addresses, phone or fax numbers, email addresses, license plate numbers, driver's license numbers and the last 6 digits of a vehicle's VIN.