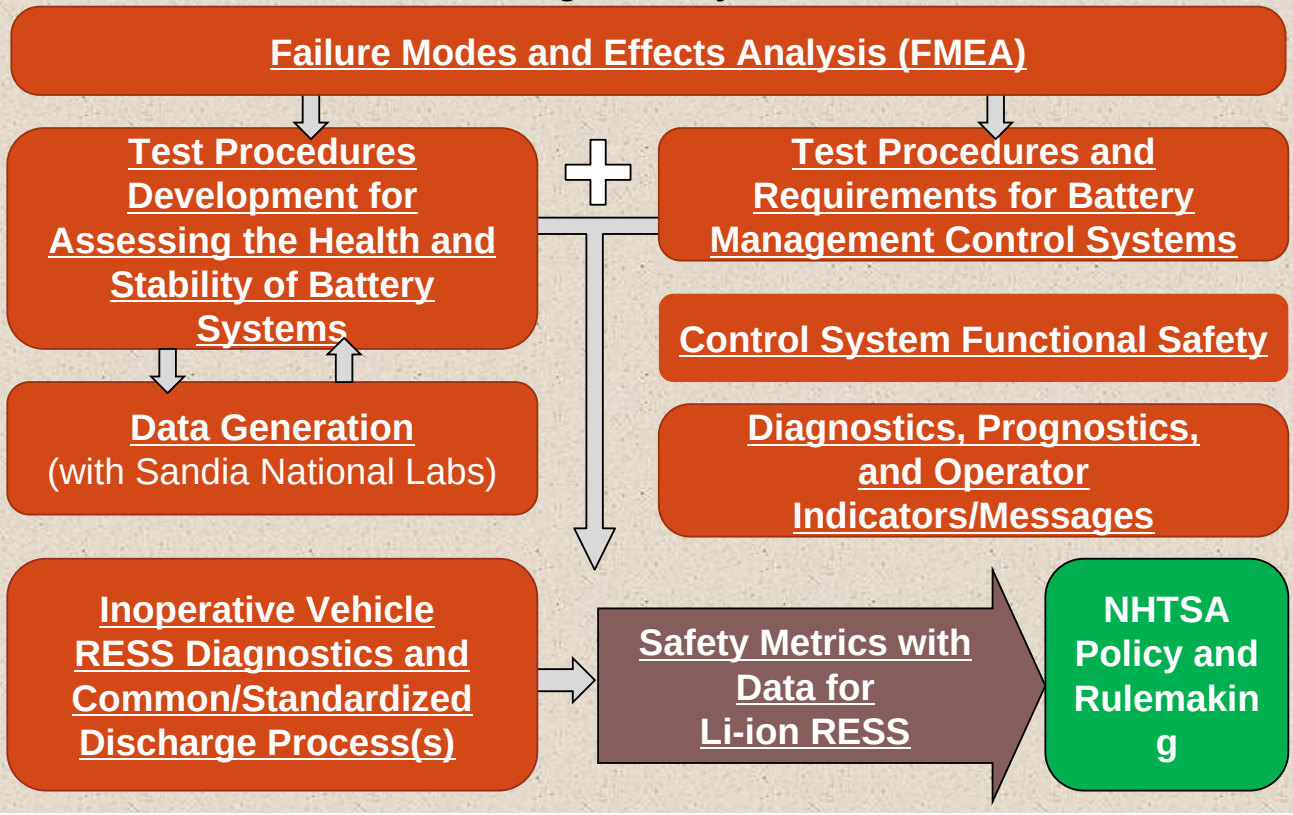

NHTSA Office of Applied Vehicle Safety Research
Crashworthiness Division

# Li-ion Based Rechargeable Energy Storage System (RESS) Safety Research Programs

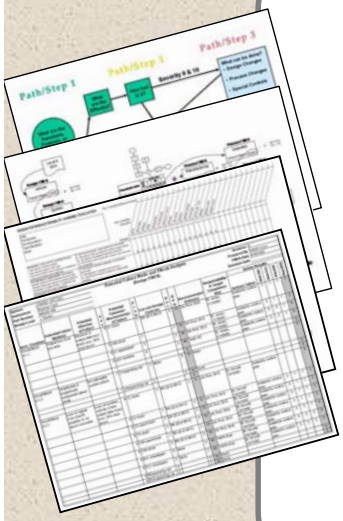
Associate Administrator - John Maddox
Office Director – Stephen Ridella
Division Chief – Stephen Summers
Research Engineer - Phillip Gorney


## RESS Research Program Projects & Process Flow




# Failure Modes and Effects Analysis

An FMEA is an analytical tool which identifies, lists, and ranks all potential failures and their corresponding effects of the product or process under investigation, in this case Li-ion based RESS Safety Performance



Battelle Memorial Institute, Columbus, OH

The results of this FMEA will be used to perform a gap analysis to existing standards and test procedures for thoroughness.

… (*including the Test Procedure Development work plans, Diagnostics and Discharge Process Development, and Control System Safety of the NHTSA research program*).

Draft Report Currently Under NHTSA Review
Calendar Year 2012
- Industry Review
- Peer Review

Becomes Living Document for Other Safety Analysis


# Test Procedure Development

Develop and document repeatable battery and vehicle level safety performance tests procedures.
- Addressing critical potential failure modes
- Addressing all areas of operation Including: Charging, Normal Operation, Crash, and Post-Crash
- Building upon the body of existing standards (SAE J2464, SAE J2929, ECE R100, Etc.)

Data generated from these test procedures will be used to accurately measure the effects of the failure modes generated by both normal and abnormal abuse conditions.
- Repeatable, Quantifiable, Comparable, Directly associated to safety risks for accurate analysis

2 Contract Awards: 24 Month Performance: October 2011 – October 2013

HONDA SAE GM NISSAN DAIMLER TOYOTA

Ford RICARDO


## Standardized Battery Assessment, and Field Discharge Procedure

The Scope of this project is to identify, develop, and demonstrate methods for the safe management and handling of RESS in post-crash and non-operational environments.

Non-operational environments may include: service, repair, end of life disassembly, vehicle crash scene, vehicle tow, and vehicle storage.

These procedures should apply to both damaged and fully functional RESS systems.

Areas of Focus:

•Definition of diagnostic protocol and common interface connector and location to support

- Diagnostic interface
- Architectural requirements
- Standardized Discharge Port/Terminal


## Battery Management Control System Performance Functional Safety

Scope: Develop a high-level analytical tool set to evaluate and/or define potential minimal control system performance requirements. Use these analytical tools to measure control redundancy and passive protection performance for each of the control sequences which may result in a failure mode identified in the FMEA.

- Exercise model and tool set to develop Fail-Safe, Hardware, Software, Diagnostic, Data Recording, and Verification requirements
- Timing – Not Projected
  - Based upon probability and/or criticality functions derived from fault tree analysis (FTA) and control logic flow diagrams
  - Separate tools for HEV, PHEV, and BEV applications
  - Potential adaptation to testing/comparing OEM systems


# Battery Management Control System Performance Operator Indicators/Messages

Scope: Define required operator warning indicators for RESS safety critical thresholds. Research predictive conditions and warnings for anticipated safety critical events.

•Establish basic Fail-Safe Conditions, Diagnostic Codes and indicators, Data Recording/Storage (e.g., EDR), and Safety Prognostic Requirements
• Utilize outputs from FMEA and Battery Discharge Procedure projects
• Utilize expertise and resources from NHTSA and Volpe Electronics Reliability Groups
• Technical approach to be determined

• Timing: 18 months - Kick Off 2012


Questions?

Thank you