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Rechargeable Energy Storage System (RESS)

Safety Research

US-China EV & Battery Workshop
August 24, 2012

Ford Battery Safety Research

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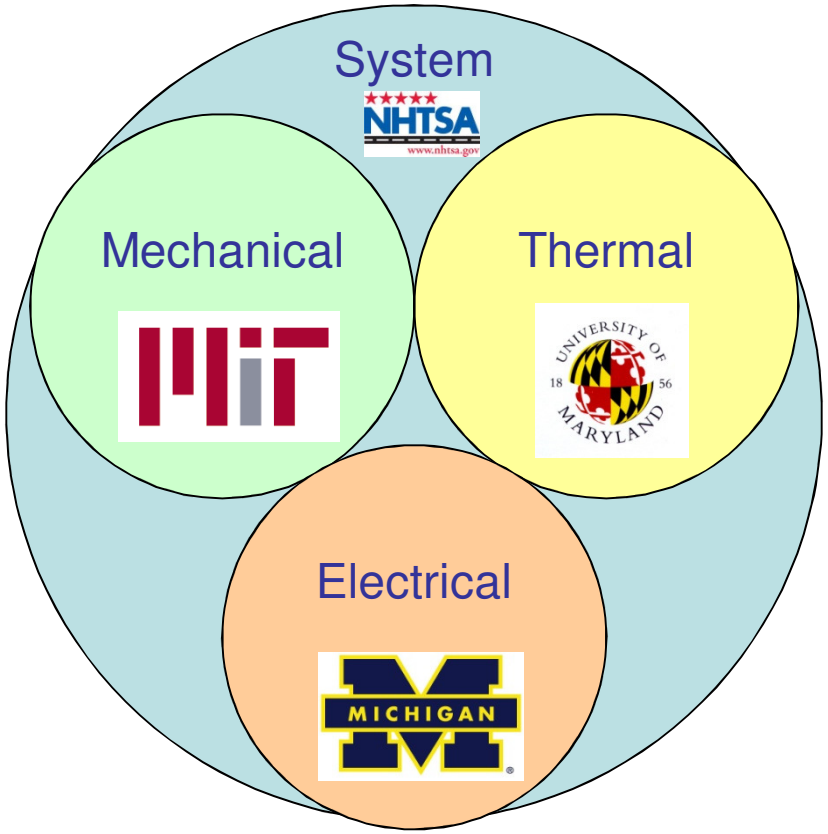
Battery Safety Hazards



Research Activity

System:

- RESS Safety
- NHTSA Award (2011 - 2013)

Mechanical:

- Ford-MIT Alliance
- Prof. Wierzbicki (2012 - 2014)

Thermal:

- U. Maryland URP
- Prof. Sunderland (2012 - 2015)

Electrical:

- Ford-UM Alliance
- Prof. Chris Mi (2012 - 2014)

NHTSA RESS Safety Solicitation

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Scope	HEV/PHEV/BEV Li-Ion Battery
Purpose	Develop Safety Test Methods & Performance Safety Metrics
Tasks	• Active – Single Failure • Passive – Single Failure + Loss of Control System
Fault Origin	• Mechanical: Crush, Penetration, Vibration, etc. • Electrical: Overcharge, Short Circuit, Overdischarge, etc. • Thermal: Fire Resistance, Thermal Control, etc.

U.S. Department of Transportation
NHTSA
www.nhtsa.gov

Timing	
Solicitation	1/26/11
Proposal	4/21/11
Award	Sept 2011
Finish	Sept 2013

NHTSA RESS Awards

Primary	Ford	SAE®
Sub-contractor	RICARDO	DAIMLER NISSAN GM

Ford NHTSA RESS Safety Project

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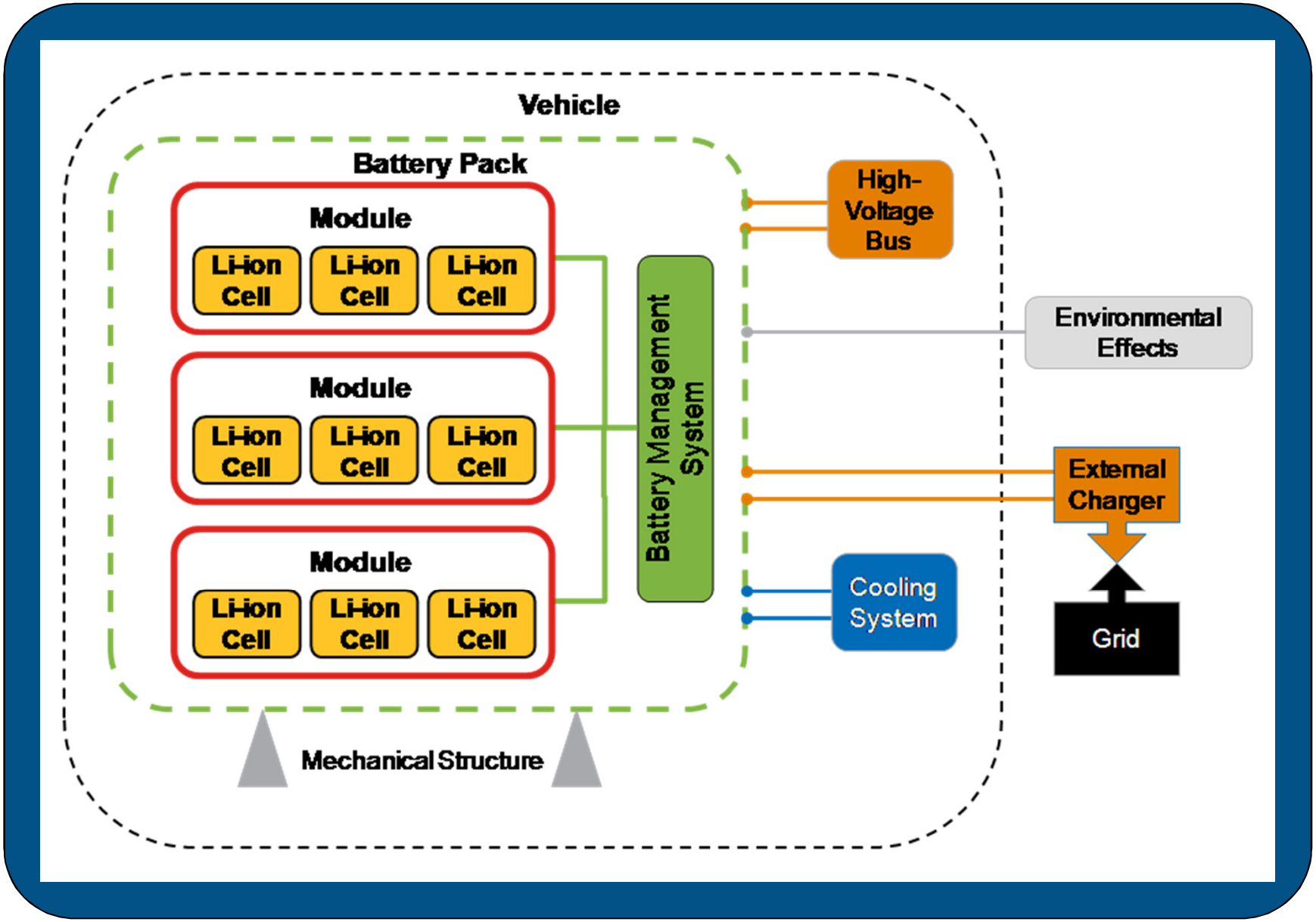
Scope	Electrified Vehicle Li-Ion Battery
Purpose	Develop Safety Test Methods & Performance Safety Metrics
Timing	Sept. 30, 2011 – Sept. 29, 2013
Tasks	• Active Safety – Single Failure • Passive Safety – Single Failure + Loss of Control System
Candidate Faults	• Mechanical: Crush, Penetration, Vibration, etc. • Electrical: Overcharge, Short Circuit, Overdischarge, etc. • Thermal: Fire Resistance, Thermal Control, etc.

Ford Approach	BEV Cells, Modules and Packs
	Subcontract with Ricardo
	Fault Tree Analysis
	Focus on Overcharge & Mechanical Crush

Boundary Diagram



Fault Tree Analysis

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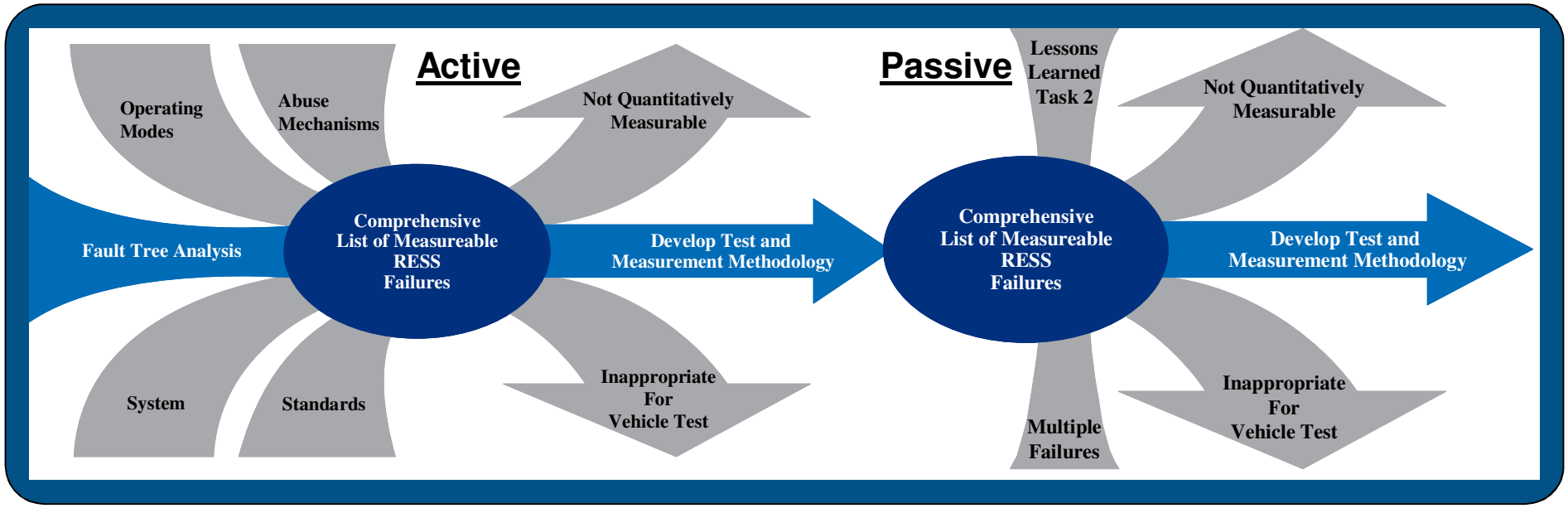

Fault Tree Analysis Scope	
1	Faults associated uniquely to Li-ion cell chemistry.
2	Considers vehicle occupants and first responders.
3	Not design specific (i.e. cell, packaging, etc.)
4	Considers new product safety performance consistent with NHTSA FMVSS testing.
5	BMS includes all related components (e.g., thermocouples, relays, conductors, etc)
6	Manufacturing defects identified but not expanded upon.
7	Design has been verified via DV (Design Validation) testing
8	Reliabilities and probabilities are not quantified

Fault Categories Investigated

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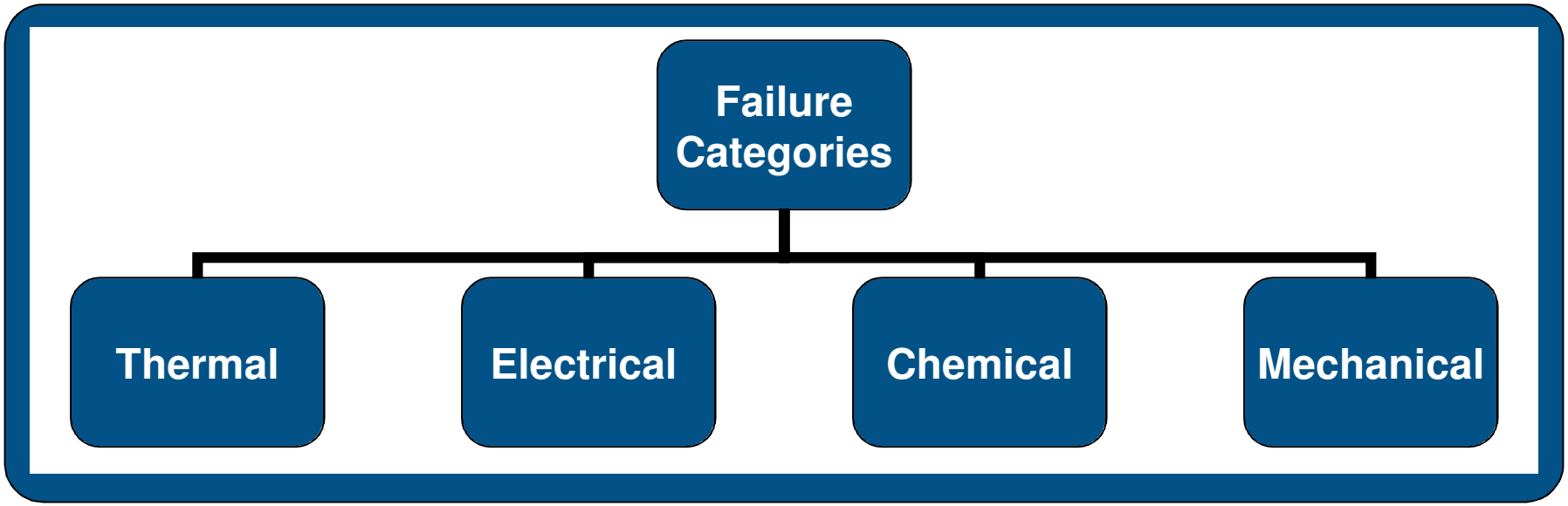

Priority Faults Identified

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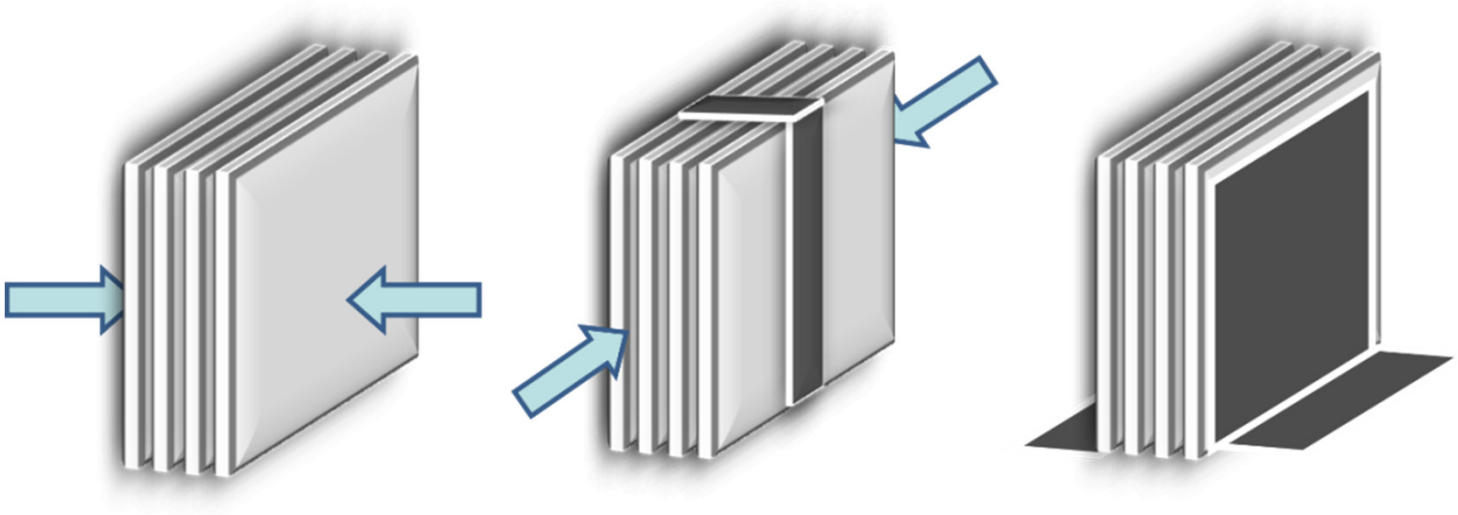
Mechanical Crush

Electrical Overcharge

Short-Circuit



Perpendicular Crush

Parallel Crush

Overcharge & Short-Circuit

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Questions