EESCC Template for Drafting Roadmap Sections 3 and 4
Example Paragraphs for Describing and Drafting Text for an Issue Area

Passages excerpted from the ANSI Standardization Roadmap for Electric Vehicles, April 2012

Section 3: Brief Discussion of Identified Issue Area

This section should provide an explanation of why specific areas were considered important and assessed as part of the roadmap.

3.1.1.2 Battery Safety*

For electric vehicles to meet their full potential in the market place, the public needs to see them as at least as safe as the vehicles they replace. Effective safety standards ensure that electric vehicles are safe for occupants, other motorists, children, service technicians, and first responders. Safety standards mainly consist of tests, intended to duplicate real-world events. Compliance to an EV battery safety standard demonstrates that the EV battery meets a minimum safety criteria established by that standard. Safety standards not only protect the public – they also help protect manufacturers from legal challenges that may arise. Vehicle manufacturers desire global harmonization of safety standards that are effective without imposing unnecessary costs or limits to innovation.

Section 4: Gap Analysis of Standards, Codes, Regulations, and Conformance Programs

This section should provide a brief description of the relevant existing and forthcoming standards, codes, and conformance programs for each issue area. Where gaps are identified, recommendations for addressing gaps should also be noted

4.1.1.2 Battery Safety*

EV battery safety standards development has been identified as a priority by standards development organizations including IEC, ISO, SAE and UL, as well as regulatory bodies such as NHTSA. As a result, a number of electric vehicle battery and related safety standards have been published or are currently under revision or development. A breakdown of this effort by organization follows:

IEC

- IEC 62660-2, Secondary batteries for the propulsion of electric road vehicles – Part 2: Reliability and abuse testing for lithium-ion cells, was published in 2010. Although not specifically identified as a safety standard, it does include tests which address safety issues such as short circuit and overcharge.

ISO

- ISO 6469-1, Electric road vehicles – Safety specifications – Part 1: On-board rechargeable energy storage system (RESS), published in 2009, provides general safety criteria to protect persons within and outside of the vehicle and applies to batteries and other RESS.

- ISO 6469-3, Electrically propelled road vehicles – Safety specification – Part 3: Protection of persons against electric shock, published in 2001 and currently under revision, addresses electrical safety of the RESS within the overall vehicle.

- ISO 12405-1, Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 1: High-power applications, was published in 2011. It is primarily focused on performance. However, it does contain tests that pertain to lithium-ion battery safety such as short circuit, overcharge, and over discharge tests.

- ISO 12405-2, Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 2: High-energy applications, is currently under development. It is similar to its Part 1 counterpart for high power applications and contains tests related to lithium-ion battery safety.

- ISO 12405-3, Electrically propelled road vehicles – Test specification for lithium-ion traction battery packs and systems – Part 3: Safety. Work has begun on this standard which will be the ISO safety standard for lithium batteries for EV applications.

SAE

- SAE J1766, Recommended Practice for Electric and Hybrid Electric Vehicle Battery Systems Crash Integrity Testing, was published in 2005 and is currently under revision. It specifically addresses electric vehicle safety concerns resulting from a vehicle crash event.

- SAE J2464, Electric and Hybrid Electric Vehicle Rechargeable Energy Storage System (RESS) Safety and Abuse Testing, recently revised in 2009, provides a series of tests with which to determine an RESS response to a potential abuse condition.

- SAE J2929, Electric and Hybrid Vehicle Propulsion Battery System Safety Standard Lithium-based Rechargeable Cells, was published in 2011. Currently under revision, this standard defines a minimum set of acceptable safety criteria for a lithium-based rechargeable battery system to be considered for use in a vehicle propulsion application as an energy storage system connected to a high voltage power train.

UL

- UL 2580, Batteries for Use in Electric Vehicles, was published as an Outline of Investigation in 2009, and as ANSI/UL 2580 in October 2011. This standard evaluates the cells, cell modules and battery pack's ability to safely withstand simulated abuse conditions. The standard is non-chemistry specific and includes construction requirements and tests to address safety of the electric energy storage assembly and modules which can consist of batteries and/or electrochemical capacitors.

NHTSA

- NHTSA FMVSS 305, Electric Powered Vehicles: Electrolyte spillage and electrical shock protection. Last revised in 2011, it is a set of requirements intended to reduce deaths and injuries during a crash, which occur because of electrolyte spillage from propulsion batteries, intrusion of propulsion battery system components into the occupant compartment, and electrical shock.

There is some movement to develop a Global Technical Regulation (GTR) under WP.29 on electric vehicle safety with batteries as a subset. At the November 2011 session of WP.29, NHTSA, Japan and the European Commission proposed a road map for the establishment of a GTR for electric

vehicles, which was endorsed by WP.29. A new IWG is expected to be formed in early 2012 to begin work to develop the GTR, which would apply to all types of hybrid and full battery electric vehicles, their batteries, and other associated high risk components. To the extent possible, the GTR will include performance-based requirements and testing protocols designed to allow for innovation, while ensuring that the unique safety risks posed by electric vehicles are mitigated. The GTR will address the safety of high voltage electrical components, including lithium-ion and other types of batteries, their performance during normal use, after a crash event, and while recharging at a residence or other charging station.

Although there has been active work in the battery safety standards area, the committee identified two gaps that need to be addressed.

Delayed battery overheating events

All of the current tested failure modes of battery systems can be classed as "real time" with regard to outcome. If a European Council for Automotive R&D (EUCAR) hazard level of greater than 2 happens – the EUCAR rating system is used in SAE J2464 – it is assumed that it happens within minutes or a few hours at most. It is now known that some faults that can create EUCAR 2 or higher events may not surface for days or even weeks. This possibility introduces a new hazard potential that could surface at any time unless expediently dealt with in a safe manner. Some of these scenarios are easily recognized and dealt with such as in vehicle accidents and with faulty chargers or battery management systems. Scenarios that are less obvious or detectable are internal partial pack circulating currents that escalate over time to dangerous thermal states. Stray currents occurring in sub sections of a pack that are intermediate in value between zero and hard shorts can evolve and generate excessive temperatures.

Gap: **Delayed battery overheating events.** The issue of delayed battery overheating needs to be addressed.

Recommendation*:* Address delayed battery overheating events in future revisions of SAE J2929. ***Priority:*** Near-term. ***Potential Developer:*** SAE.

Loss of control/dual mode failure in the battery

NHTSA has recognized this particular failure mode which can best be characterized as a double fault condition in the battery system. Some examples of loss of control/dual mode failure events would include: a failure of overcharge protection when the battery is overheated, overheating during a crash event, or a cell thermal runaway event within the battery. SAE J2929 currently focuses on single point failures. NHTSA has plans to research these types of double fault events for consideration in future rulemaking, and has awarded research grants to SAE among others. SAE TEVVBC1 plans to integrate the results of this research into future revisions of SAE J2929.

Gap: **Loss of control/dual mode failure in the battery.** The issue of double fault conditions in the battery needs to be addressed.

Recommendation: Future revisions of SAE J2929 should address loss of control/dual mode failure events such as a failure of overcharge protection when the battery is overheated, overheating during a crash event, or a cell thermal runaway event within the battery. ***Priority:*** Mid-term. ***Potential Developer:*** SAE.