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Battery Management System Standards

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(working group chair)

IEEE P2686 Recommended Practice for Battery Management Systems in Stationary Energy Storage Applications

The IEEE P2686 working group has spent FY20 writing content of the first complete draft. We have completed writing the first draft of the clause that describes battery management technologies and functions and expect to have a completed draft of all three clauses by February of 2021. An in person meeting was held in February and two virtual meetings were held in June and July. We expect first balloting to take place in early 2022.

Working Scope / Purpose

Scope:

This recommended practice includes information on the design, installation, and configuration of battery management systems in stationary applications, including both grid-interactive, standalone cycling and standby modes. This document covers battery management hardware, software, and configuration. Hardware capabilities in large systems include: grounding and isolation; passive and active balancing; and wired or wireless sensors. Software capabilities include: algorithms for optimal operation with reduced risk; best practices for verification and validation; alarms; and communication with external systems. Common settings are discussed along with setting selection methods. Battery types that this document covers include lithium-ion, sodium-beta, advanced lead-acid, and flow batteries. General factors for other types are provided. Transportable energy storage systems that are stationary during operation are included in this standard

This document does not cover battery management systems for mobile applications such as electric vehicles; nor does it include energy management in vehicle-to-grid applications. Energy management systems, which control the dispatch of power and energy to and from the grid, are not covered.

Purpose

Well-designed battery management is critical for the safety and longevity of batteries in stationary applications. This document is intended to inform battery system designers and integrators in the challenges to battery management design. This document assists in the selection between design options by supplying the pros and cons of a range of technical solutions.

Many aspects of battery management design require integration with other systems such as energy management or charge control systems. System integration can be made difficult or impossible without a minimal level of communication interface and control interface standardization. To address this issue, this document offers recommendations and best practices for interface design to streamline system integration.

How to use this document

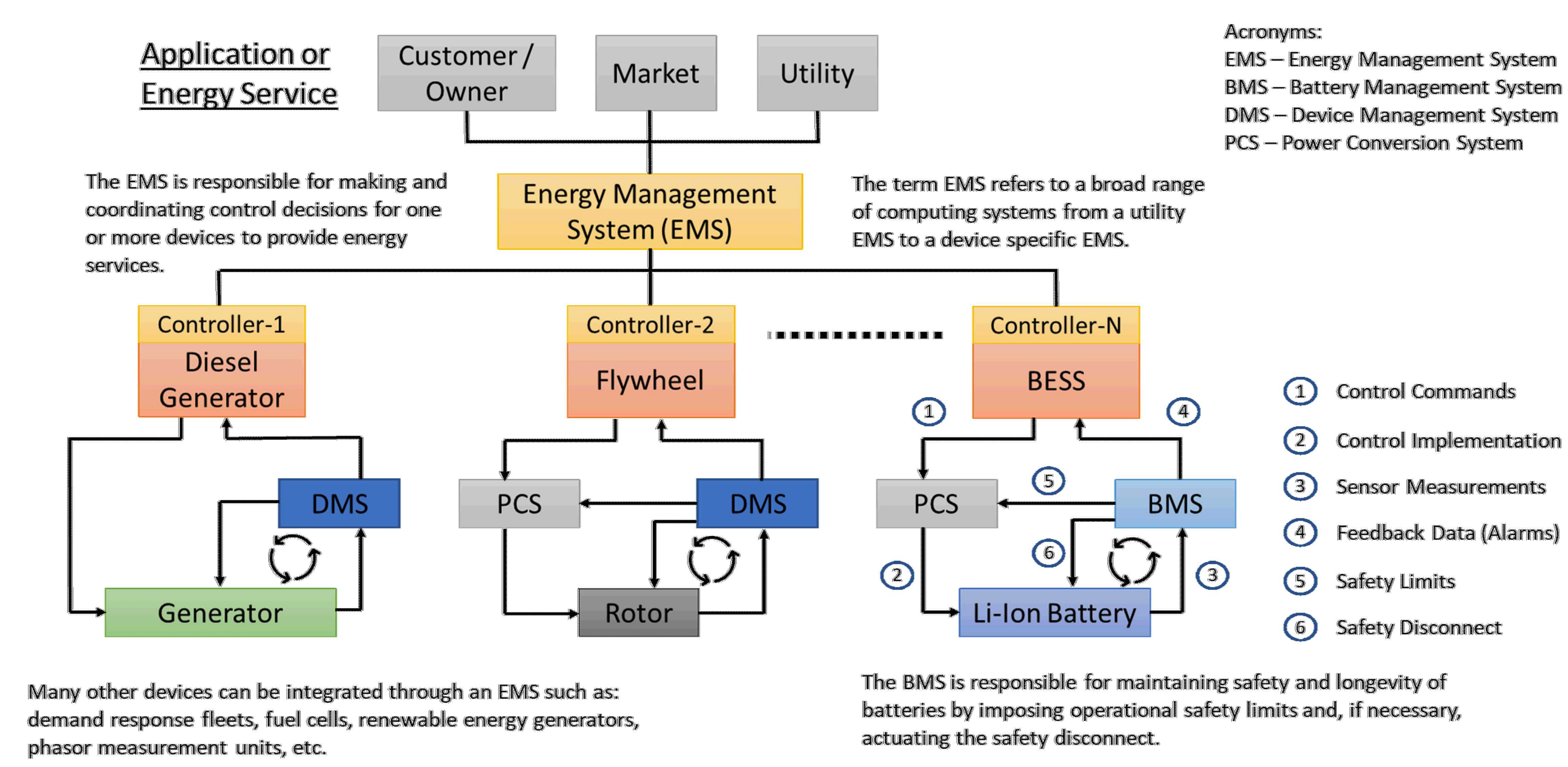
This document is structured to make it easy to navigate for three intended audiences: general interest, BMS design engineers, and system integrators. For readers who have a general interest in BMS technologies we recommend starting with Section 5 as this describes the hardware, software, and functional logic that makes up a BMS. For readers who intend to use this to design or re-configure a BMS for a specific battery in a specific application we recommend starting with Section 6 on BMS Configuration by application and battery type. Section 6 provides a list of best practices for which BMS functions should be implemented with regards to the battery type and its intended usage. For readers who integrate an existing BMS into a battery energy storage system we recommend starting with Section 7 as this describes the communications interface between the BMS and other devices.

Expected Timeline

- 2018 – PAR submitted to IEEE
- 2019 – WG Kickoff Meeting
- 2020 – Drafting Sections
- 2021 – Review/Editing
- 2022 – Balloting

Introduction (Draft Content Excerpt)

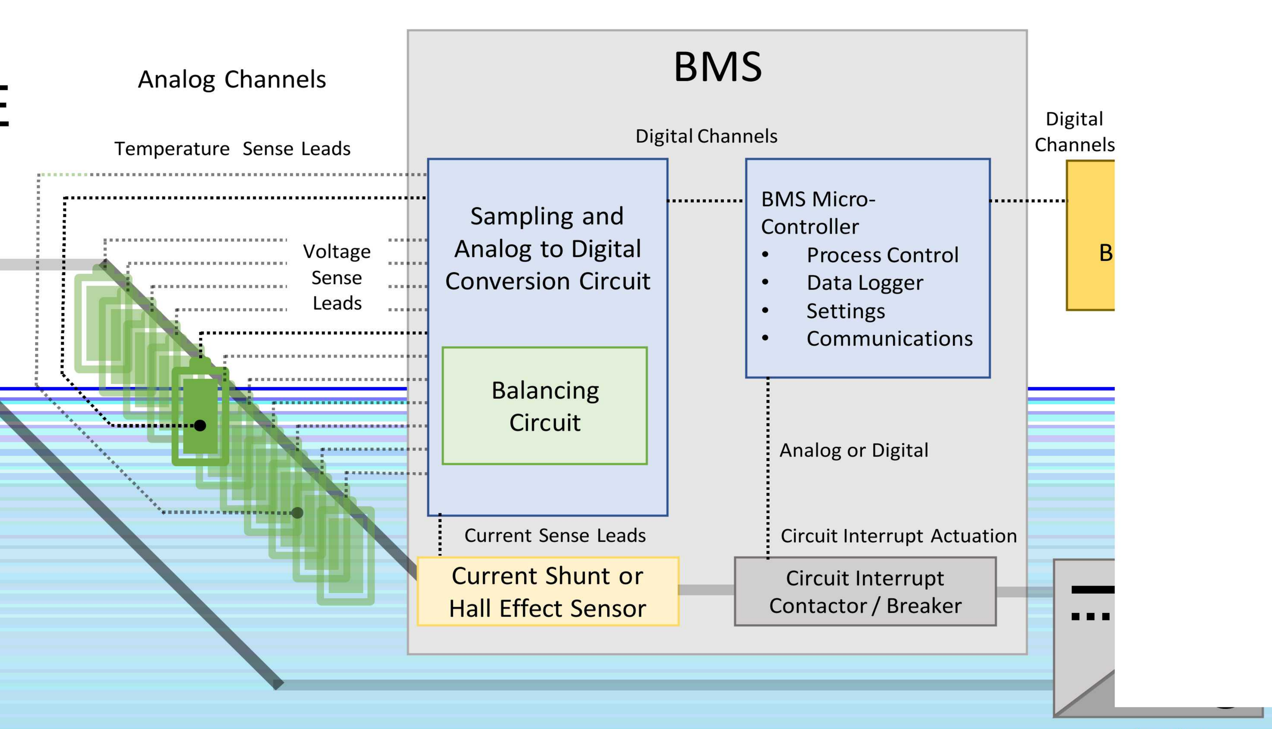
The role of battery management in stationary energy storage systems is distinct from battery management in electric vehicles or consumer electronics. In stationary energy storage systems, decisions about when and how much to charge/discharge the batteries are mostly delegated to the EMS or charger, while the BMS is responsible for enforcing a safe operating window. To accomplish this task, the BMS acts within one or more control loops as illustrated in Figure 2. Often, the BMS has direct control of an interrupt device that opens the battery circuit to protect the battery from hazardous operation. Additionally, the BMS can elevate warnings or alarms to the EMS, which is then responsible for appropriately restricting operation. This active role distinguishes a BMS from a battery monitoring system [IEEE 1491]. Note that a BMS can include functions that take direct control of charge or discharge. Examples of this include periodic equalization charge in lead-acid systems, or dendrite stripping cycles in zinc-bromide flow battery systems. The functional distinction is that the purpose of battery management is to maintain battery safety and longevity, and so they generally supersede economic concerns or grid conditions, though not always.



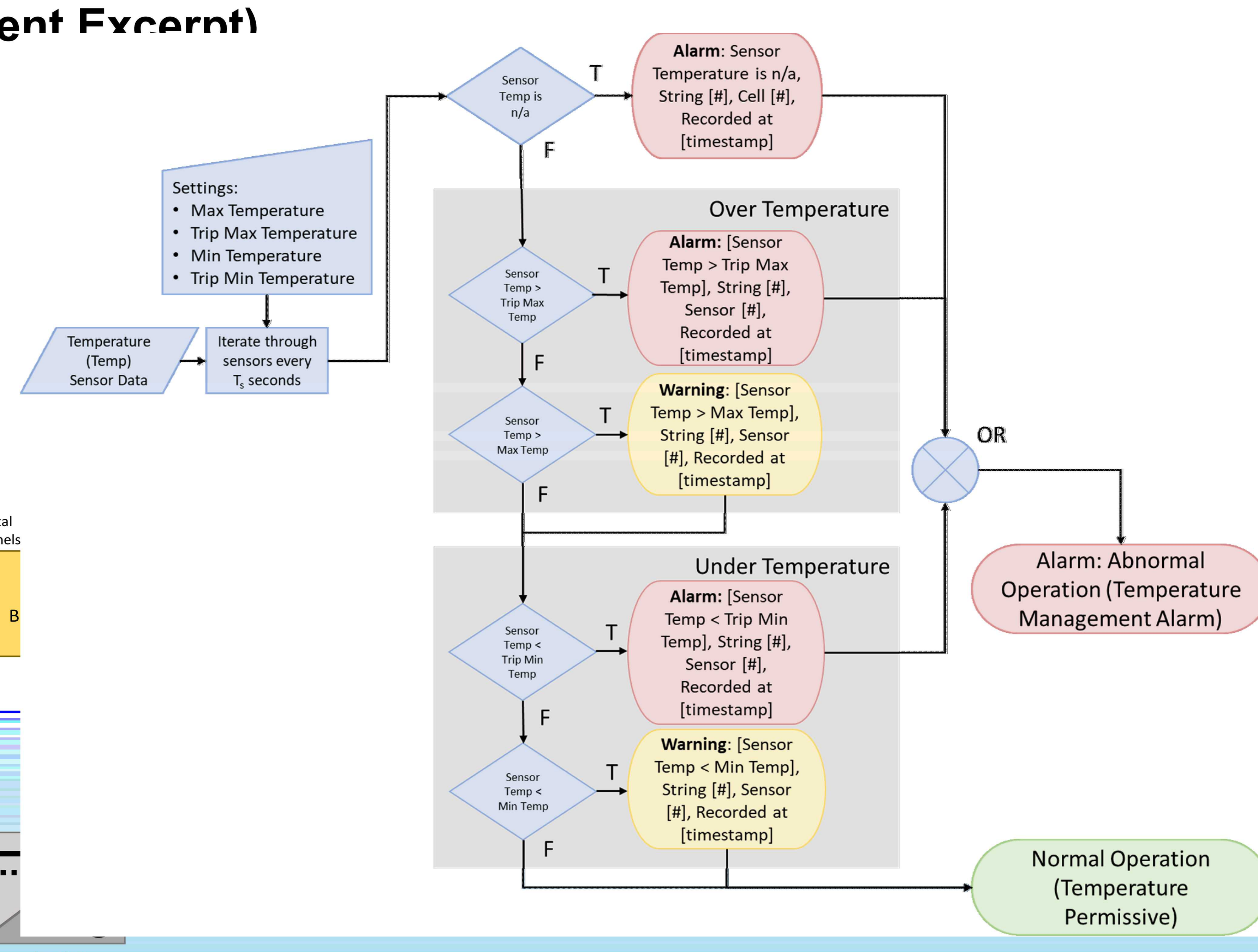
Example Control Diagram for EMS and BMS

Technology Description (Draft Content Excerpt)

The BMS is the supervisory control system that ensures functionality of the battery pack while maintaining safe operating conditions and reacting appropriately to contingencies. This section provides a brief description of some critical functions of the BMS. Each function description consists of an objective (task fulfilled by the function), input, output and effect on system. Effect on system describes the outcome on the system state when the function is triggered. This section provides a brief description of some critical functions of the BMS. Each function description consists of an objective (task fulfilled by the function), input, output and effect on system. Effect on system describes the outcome on the system state when the function is triggered.



Battery Management Functional Block Diagram



Example Temperature Management Process Flow Diagram

If you have knowledge of BMS design and would like to participate in the development of a new IEEE recommended practice, then please contact the working group chair, David Rosewater dmrose@sandia.gov, and join us for the next digital working group meeting.

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