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Foreword

At the request of the Fire Protection Research Foundation (FPRF), exponent performed a fire hazard assessment of lithium-ion (Li-ion) batteries used in energy storage systems (ESSs). This book summarizes a literature review and gap analysis related to Li-ion battery ESSs, as well as full-scale fire testing of 100-kWh Li-ion battery ESSs. The scope of services performed during this literature review and testing program may not adequately address the needs of other users of this book, and any reuse of this book or the findings, conclusions, or recommendations presented herein are at the sole risk of the user.

The full-scale Li-ion battery ESS test strategy, ignition protocols, and any recommendations made are strictly limited to the test conditions included and detailed in this book. The combined effects (including, but not limited to) of different battery types, ESS types, ESS size/battery capacity, internal or external ESS/battery damage, battery energy density and design, state of charge, and cell chemistry are yet to be fully understood and may not be inferred from these test results alone.

The findings formulated in this review are based on the observations and information available at the time of writing. The findings presented herein are made to a reasonable degree of scientific and engineering certainty. If new data become available or there are perceived omissions or misstatements in this book, we ask that they be brought to our attention as soon as possible so that we have the opportunity to fully address them.

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Preface

In an effort to provide guidance to standards developers, authorities having jurisdiction (AHJs), emergency responders, and the energy storage system (ESS) industry, exponent, in conjunction with FPRF, the Project Technical Panel, and industry sponsors, performed a fire hazard assessment of Li-ion battery ESSs. Currently, these entities do not have a clear direction regarding the fire hazards of ESS installations and have few, if any, technical studies, reports, or scientific literature to rely upon when making decisions regarding the safe installation of these systems. This book summarizes a literature review and gap analysis related to Li-ion battery ESSs, as well as full-scale fire testing of a 100-kWh Li-ion battery ESS.

The scope of work included, but was not limited to, the following four primary tasks:

1. A literature review and gap analysis related to Li-ion battery ESSs;
2. Development of a detailed full-scale fire testing plan to perform an assessment of Li-ion battery ESS fire hazards;
3. Witnessing the implementation of the fire test plan through full-scale fire testing; and
4. A report of final results and a fire hazard assessment.

The overall project research objective was to develop a technical basis through a fire hazard assessment of Li-ion battery ESSs. This project is the first phase of an overall initiative with the goal to develop safe installation practices, fire protection guidance, and appropriate emergency response tactics for Li-ion battery ESSs based on the literature review and full-scale test results, as applicable. This project did not include an analysis or testing of fire detection systems, fire suppression systems, or emergency response tactics related to Li-ion battery ESS fire scenarios. A full listing of project observations/key findings as they relate to ESS fire hazards is provided in Chap. 7 of this book.

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