TEST REPORT
ANSI/CAN/UL 9540A:2025
TUV SUD Test Report for
Unit Level – Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Report No.:	64.280.25.60772.01
Date of issue:	2026-01-07
Project handler:	Julie Liao, Tao Xia
Testing laboratory: Address: Testing location:	TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch 5F, Communication Building, 163 Pingyun Rd, Huangpu West Ave. Guangzhou 510656 P.R. China TÜV SÜD New Energy Testing and Certification (Guangdong) Co., Ltd. North-1/F, 2/F & Unit 301-3/F, TUV SUD Testing Center, D1, No. 63 Chuangqi Road, Shilou Town, Panyu District, Guangzhou, Guangdong, China
Client: Client number: Address: Contact person:	Huawei Digital Power Technologies Co., Ltd. N/A Office 01, 39th Floor, Block A, Antuoshan Headquarters Towers, 33 Antuoshan 6th Road, Futian District, Shenzhen, 518043, P.R.C. Cui Xiaolong
Standard: TRF number and revision: eDoc_ID: TRF originated by:	This TUV SUD test report form is based on the following requirements: ANSI/CAN/UL 9540A:2025 Fifth Edition (5Ed) TRF ANSI/CAN/UL 9540A:2025 Rev 0 TÜV SÜD New Energy Testing and Certification (Guangdong) Co., Ltd. Mrs. Zoey Liu
Copyright blank test report: General disclaimer:	This test report is based on the content of the standard (see above). The test report considered selected clauses of the a.m. standard(s) and experience gained with product testing. It was prepared by TUV SUD Product Service. TUV SUD Group takes no responsibility for and will not assume liability for damages resulting from the reader's interpretation of the reproduced material due to its placement and context. This test report may only be quoted in full. Any use for advertising purposes must be granted in writing. This report is the result of a single examination of the object in question and is not generally applicable evaluation of the quality of other products in regular production.
Scheme:	☐ TUV Mark ☐ cTUV Mark (SCC) ☐ TUVus Mark (NRTL) ☐ GS Mark ☒ without certification ☐ other: ☐ AoC/CoC for EU-Directive / EU-Regulation:
Non-standard test method: National deviations:	☒ No ☐ Yes, see details under *Summary of testing* N/A
Number of pages *(Report)*: Number of pages *(Attachments)*:	64 (including all Attachments) 22 (from page 43 to 64)

Compiled by: (+ signature)	Tao Xia Tao Xia	Supervised by: (+ signature)	Julie Liao Julie Liao	Approved by: (+ signature)	Zoey Liu

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Test sample:	Smart String ESS
Type of test object:	Protype Sample
Trademark:	HUAWEI
Model and/ or type reference:	LUNA2000-241-2S1, LUNA2000-241-2S1-CN
Rating(s):	768 Vd.c., 314 Ah

Manufacturer:	Same as the client
Manufacturer number:	N/A
Address:	Same as the client

Name and address of factory(ies)

Factory 1:

Shenzhen Huahao Mechanical & Electrical Co Ltd Dongguan Branch Company

No.738, Meijing Middle Road, Changtang Community, 523779 Dongguan City, Guangdong, PEOPLE'S REPUBLIC OF CHINA

Factory 2:

Huizhou EVE New Energy Solutions Co.,Ltd.

No. 28, Junmin Road, (Tonghu Town, Sanhe Village), Huicheng District, 516039 Huizhou, Guangdong, PEOPLE'S REPUBLIC OF CHINA

Sub-contractors / tests (clause):	N/A
Name:	N/A
Order description:	☒ Complete test according to TRF
	☐ Partial test according to manufacturer's specifications
	☐ Preliminary test
	☐ Spot check
	☐ Others:
Date of order:	2025-11-12
Date of receipt of test item:	2025-11-12
Date(s) of performance of test:	2025-11-14 to 2026-01-06

Test item particulars:

According to Unit Level of ANSI/CAN/UL 9540A:2025 Fifth Edition.

Purpose of the product (description of intended use):

The Smart String ESS, model: LUNA2000-241-2S1 and LUNA2000-241-2S1-CN are used in industrial applications (Outdoor ground mounted non-residential installation and indoor floor mounted non-residential installation).

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Characteristic data (not shown on the marking plate):

The Smart String ESS, model: LUNA2000-241-2S1 and LUNA2000-241-2S1-CN consist of 4pcs Rechargeable Lithium Ion Battery (Energy Storage Module), model: LUNA2000-60-2E1 connected in 4S. Rechargeable Lithium Ion Battery (Energy Storage Module), model: LUNA2000-60-2E1 consists of 60pcs Rechargeable Li-ion Cell (model no.: SBP-01-3140) connected in 60S. In the battery module, the nozzle is an optional component.

The Smart String ESS with different models have the same hardware and software except below component:

1. LUNA2000-241-2S1 consists of 4pcs Rechargeable Lithium Ion Battery (Energy Storage Module), model: LUNA2000-60-2E1 (without the nozzle).
   LUNA2000-241-2S1-CN consists of 4pcs Rechargeable Lithium Ion Battery (Energy Storage Module), model: LUNA2000-60-2E1 (with the nozzle).
   The function of nozzle is transferring Perfluoro (2-methyl-3-pentanone) into the module to restrain the thermal runaway when the temperature in module reaches the limit.
2. The manufacturer declared the Smart String ESS, model: LUNA2000-241-2S1 as the test unit.

View of Rechargeable Lithium Ion Battery (Energy Storage Module), model: LUNA2000-60-2E1, with the nozzle and without the nozzle:

With the nozzle:

Without the nozzle:

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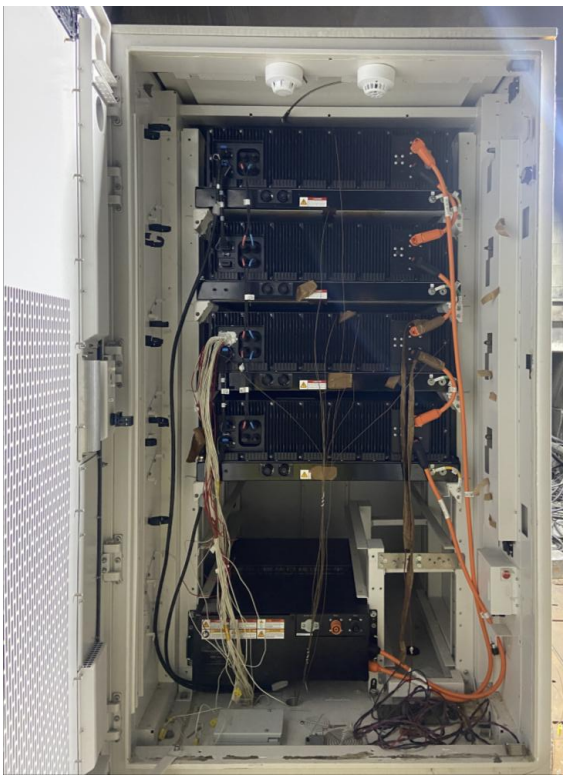
View of Smart String ESS, model: LUNA2000-241-2S1



Product name	Smart String ESS
Type/model	LUNA2000-241-2S1, LUNA2000-241-2S1-CN
Nominal voltage	768 Vd.c.
Rated capacity	314 Ah
Charging voltage specified by manufacturer	852 V, any battery module voltage reaches 213 V or any cell voltage reaches 3.65 V.
Charging power specified by manufacturer	108 kW
Maximum continuous charging power	108 kW
Discharging power specified by manufacturer	108 kW
Maximum continuous discharging power	108 kW
End of discharge voltage	Any battery module voltage reaches 162 V or any cell reaches 2.5 V
Standard charging method specified by manufacturer	Charge at constant power 108 kW until any battery module voltage reaches 213 V or any cell voltage reaches 3.65 V.
Standard discharging method specified by manufacturer	Discharge at constant power 108 kW until any battery module voltage reaches 162 V or any cell voltage reaches 2.5 V.
Dimension	Width*Depth*Height: 1150 mm*1800 mm*2100 mm
Weight	Approx. 2800 kg
Number of cells and configuration	240 cells, (60S)4S

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Attachments:

Attachment 1: Product description
Attachment 2: Exploding drawing of module & Identification/location of cells within the module
Attachment 3: Pre-conditioning profile
Attachment 4: Photo(s) for sample(s) before test and test setup with thermocouple location
Attachment 5: Photo(s) for sample(s) after test
Attachment 6: Monitored temperature chart
Attachment 7: Flammable gas generation and composition data chart
Attachment 8: Heat release rate versus time data chart
Attachment 9: Peak smoke release rate and total smoke release data chart
Attachment 10: Summary of Heat release rate & Peak smoke release rate and total smoke release data

If additional information is necessary, please provide

N/A

Copy of marking plate:

Test unit: Model: LUNA2000-241-2S1

Model: LUNA2000-241-2S1-CN

Remark: The date of manufacture will be displayed on the label in the form “YYYY-MM-DD”.

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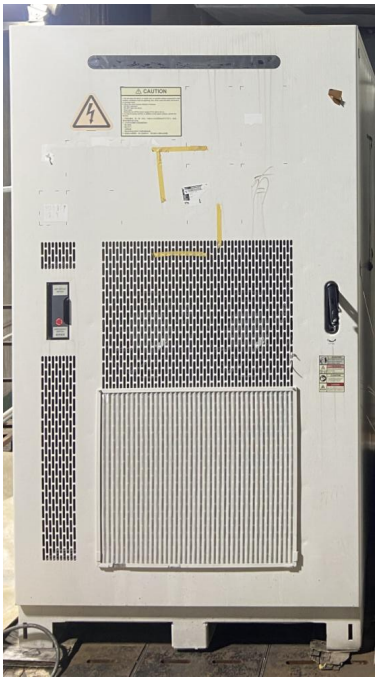
Pictures of the product:



Summary of testing:

>>>> unit level testing:

Unit model name	LUNA2000-241-2S1
Ratings	768 Vd.c., 314 Ah
Whether UL 1973 compliant	No related documentation was provided
Number of modules in the initiating BESS unit	4
The construction of the initiating BESS unit per 5.3	See Attachment 1
Fire protection features/detection/suppression systems within unit	No fire protection features/detection/ suppression systems within unit
Module voltage(s) corresponding to the tested SOC	See Table 1
The thermal runaway initiation method used	Heating the cell with externally applied flexible film heaters that cover two widest side surfaces of the cell, Film heater: 800 W/pcs, 2 pcs
Location of the initiating module within the BESS unit	See Attachment 4
Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, and soffits	See Attachment 4
Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension	No flaming outside the initiating BESS enclosure
Chemical and convective heat release rate versus time data	See Attachment 8, 10
Separation distances from the initiating BESS unit to target walls (e. g. distances A and C in Figure 9.1)	See Attachment 4
Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and H in Figure 9.1);	See Attachment 4

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The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple	See Table 3 and Attachment 4 and 6
The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple	See Attachment 4
The maximum incident heat flux on target wall surfaces and target BESS units	Target wall surfaces: 0 kW/m^2 Target BESS unit: 0 kW/m^2
The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test	N/A
Gas generation and composition data	See Table 2 and Attachment 7
Peak smoke release rate and total smoke release data	See Attachment 9, 10
Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred	No integral fire protection systems within unit
Observation of flying debris or explosive discharge of gases	No observation of flying debris or explosive discharge of gases
Observation of re-ignition(s) from thermal runaway events	N/A (no fire during test)
Observation(s) of sparks, electrical arcs, or other electrical events	No observation of sparks, electrical arcs or other electrical events
Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; 3) Adjacent walls, ceilings, or soffits;	See Attachment 5 1) The initiating cell (Cell 23) and other cells (Cell 24 and Cell 25) occurred thermal runaway in the initiating module; 2) No damage to target BESS units; 3) No damage to adjacent walls, ceilings, or soffits.
Performance at unit level testing:	
☒ Non-Residential Installations: ☒ Indoor Floor Mounted ☒ Outdoor Ground Mounted ☐ Indoor Wall Mounted ☐ Outdoor Wall Mounted ☐ Rooftop and Open Parking Garages	
a) Flaming outside the initiating BESS unit is not observed; (for Indoor Floor Mounted & Indoor Wall Mounted)	No flaming outside the initiating BESS unit is observed
a) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; (for Outdoor Ground Mounted & Outdoor Wall Mounted & Rooftop and Open Parking Garages)	The maximum temperature of target modules within the target BESS units adjacent to the initiating BESS unit is 23.2 °C

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b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; (for Indoor Floor Mounted & Indoor Wall Mounted)	The maximum temperature of target modules within the target BESS units adjacent to the initiating BESS unit is 23.2 °C
b) For BESS units intended for installation near exposures, surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; (for Outdoor Ground Mounted)	The maximum temperature of wall surface is 21.1 °C
b) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; (for Outdoor Wall Mounted & Rooftop and Open Parking Garages)	N/A
c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; (for Indoor Floor Mounted & Indoor Wall Mounted)	The maximum temperature of wall surface is 21.1 °C
c) Explosion hazards are not observed, including deflagration or detonation; (for Outdoor Ground Mounted & Outdoor Wall Mounted)	No explosion hazards were observed
c) For BESS units intended for installation on combustible roof constructions, surface temperature measurements on roof surfaces do not exceed 97 °C (175 °F) temperature rise above ambient per 9.6.5; (for Rooftop and Open Parking Garages)	N/A
d) Explosion hazards are not observed, including deflagration or detonation. (for Indoor Floor Mounted & Indoor Wall Mounted & Rooftop and Open Parking Garages)	No explosion hazards were observed
d) Heat flux measured at the minimum distance to a means of egress specified by the manufacturer shall not exceed 1.3 kW/m^2. (for Outdoor Ground Mounted & Outdoor Wall Mounted)	Heat flux measured at the minimum distance to a means of egress specified by the manufacturer is 0.007 kW/m^2
e) For BESS units intended for installation in open parking garages, heat flux measured at the distance from the BESS to the means of egress shall not exceed 1.3 kW/m^2. (for Rooftop and Open Parking Garages)	N/A
☐ Residential Installations: ☐ Indoor Floor Mounted ☐ Outdoor Ground Mounted ☐ Indoor Wall Mounted ☐ Outdoor Wall Mounted	
a) Charring or ignition of the cheesecloth indicator is not observed; (for Indoor Floor Mounted & Outdoor Wall Mounted)	N/A
a) Flaming outside the initiating BESS unit is not observed; (for Outdoor Ground Mounted)	N/A

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a) Flaming outside the initiating BESS unit is not observed as demonstrated by no flaming or charring of the cheesecloth indicator; (for Indoor Wall Mounted)	N/A
b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10;	N/A
c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; (for Indoor Floor Mounted & Indoor Wall Mounted & Outdoor Wall Mounted)	N/A
c) For BESS units intended for near exposures, surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; (for Outdoor Ground Mounted)	N/A
d) Explosion hazards are not observed, including deflagration or detonation;	N/A
e) The concentration of flammable gas does not exceed 25% LFL in air for the smallest specified room installation size. (for Indoor Floor Mounted & Indoor Wall Mounted)	N/A
e) Heat flux measured at the minimum distance to a means of egress shall not exceed 1.3 kW/m^2. (for Outdoor Ground Mounted & Outdoor Wall Mounted)	N/A

Performance - module level test: (tested by: TÜV SÜD Certification and Testing (China) Co., Ltd. Guangzhou Branch, report no.: 64.280.25.60771.01)	
a) Vent gas is nonflammable as determined by the cell level test;	The cell vent gas presented a flammability hazard
b) There is no spread of flame outside of the module; and	No spread of flame outside of the module
c) The module exterior surface temperature does not exceed the cell venting temperature as measured adjacent to the initiating cell where the greatest thermal exposure is anticipated.	The module exterior surface temperature did not exceed the cell venting temperature

>>>> module level test report summary:

Module model number	LUNA2000-60-2E1
Nominal voltage and rated capacity	192 Vd.c., 314 Ah
Number of cells in module and module configuration	60 cells (60S)
Whether UL 1973 compliant	No related documentation was provided
Module voltage corresponding to the tested SOC	202.9 V
Method used to initiate thermal runaway	Heating the cell with externally applied flexible film heaters that cover two widest side surfaces of the cell Film heater: 800 W/pcs, 2 pcs
Thermal runaway of other cells within module:	Cell 24 and Cell 25
Heat release rate versus time data	Peak heat release rate: 4.846 kW

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Peak smoke release rate and total smoke release data	Peak smoke release rate: 0.253 m^2/s Total smoke release: 184.769 m^2
Flammable gas generation and composition data	See Module vented gas composition table
Observation(s) of flying debris:	No flying debris observed
Observation(s) of explosive discharge of gas:	No explosive discharge of gas observed
Observation(s) of sparks, electrical arcs or other electrical events:	No sparks, electrical arcs or other electrical events observed
Locations and visual estimations of flame and duration from the module	No flame observed
Re-ignitions	N/A (No flame during test)

Module vented gas composition:

Composition	Chemical formula	Measurement peak (L/s)	Measurement (L)	Analysis Method
Carbon monoxide	CO	0.0471	1.1956	FTIR
Carbon dioxide	CO_2	0.1743	21.1066	FTIR
Methane	CH_4	0.0343	0.9845	FTIR
Acetylene	C_2H_2	0.0023	0.0261	FTIR
Ethene	C_2H_4	0.0293	0.5538	FTIR
Methanol	CH_4O	0.0099	0.6977	FTIR
Dimethyl carbonate	$C_3H_6O_3$	0.0403	1.1049	FTIR
Ethyl methyl carbonate	$C_4H_8O_3$	0.0210	0.2255	FTIR
Total Hydrocarbons	(Propane Equivalent)	-	57.0643	FID

Performance - cell level test: (tested by: TÜV Rheinland (Shanghai) Co., Ltd., report no.: CN25MDIJ 001)	
a) Thermal runaway cannot be induced in the cell; and	Thermal runaway was induced in the cell
b) The cell vent gas does not present a flammability hazard when mixed with any volume of air, as determined in accordance with ASTM E918 at both ambient and vent temperatures.	The cell vent gas presented a flammability hazard

>>>> cell level test report summary:

Cell manufacturer name	Sunwoda Mobility Energy Technology Co., Ltd.
Cell model number	SBP-01-3140
Nominal voltage and rated capacity	3.2 V, 314 Ah
Cell chemistry (e.g. NMC, or LFP)	LFP
Physical format (i.e. prismatic, cylindrical, pouch)	prismatic
Whether UL 1973 compliant	Complied with UL 1973 Report No.: SZES250300163661 Cert. No.: SGSNA/25/SZ/00082U

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Method used to initiate thermal runaway	Two external film heaters
Average vent temperature of the samples tested excluding the gas collection sample	169.8 °C
Average thermal runaway temperature of the samples tested excluding the gas collection sample	228.6 °C
The lower flammability limit of the cell vent gas at ambient temperature	8.1 %
The lower flammability limit of the cell vent gas at vent temperature	7.3 %
Burning velocity of the cell vent gas	0.486 m/s
P_{max} of the cell vent gas	0.782 MPa

Cell vented gas composition:

Composition	Chemical formula	Re-normalized, %
Hydrogen	H_2	41.989
Carbon monoxide	CO	11.505
Carbon dioxide	CO_2	33.421
Methane	CH_4	5.802
Ethane	C_2H_6	0.682
Ethene	C_2H_4	4.931
Acetylene	C_2H_2	0.191
Propane	C_3H_8	0.165
Propene	C_3H_6	0.611
Propyne	C_3H_4	0.024
Butene	C_4H_8	0.462
Butane	C_4H_{10}	0.057
Butadiene	C_4H_6	0.160
Total		100

☐ deviation(s) found

☐ no deviations found

The product fulfils the requirements of: ☒ UL 9540A (as indicated on page 1)

☒ CAN/UL 9540A (as indicated on page 1)

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Additional information on non-standard test method(s)	
Sub clause:	N/A
Page:	N/A
Rational:	N/A

Possible test case verdicts:	
test case does not apply to the test object:	N/A (not applicable / not included in the order)
test object does meet the requirement:	P (Pass)
test object does not meet the requirement:	F (Fail)

General remarks:

"(see remark #)" refers to a remark appended to the report.

"(see appended table)" refers to a table appended to the report.

Throughout this report ***a*** ☐ ***Comma /*** ☒ ***Point*** *is used as the decimal separator.*

The test results presented in this report relate only to the object tested.

This report shall not be reproduced except in full without the written approval of the testing laboratory.

Remark:

Decision rule according to ILAC-G8:09/2019 clause 4.2.1 Binary statement for simple acceptance rule or IEC Guide 115:2023, clause 4.3.3 Simple acceptance was applied.

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict

INTRODUCTION

1.	**Scope**		—
2	**Units of Measurement**		—
3	**Normative References**		—
4	**Glossary**		—

CONSTRUCTION

5.	**General**		P
5.1	**Cell**		P
5.1.1	The cells associated with the BESS that were tested shall be documented in the test report, including cell chemistry (e.g. NMC, LFP), the physical format of the cell (i.e. prismatic, cylindrical, pouch), cell electrical rating in capacity and nominal voltage, the overall dimensions of the cell, and weight.		P
5.1.2	The cell documentation included in the test report shall indicate if the cells associated with the BESS comply with UL 1973.	Complied with UL 1973: Report No.: SZES250300163661 Cert. No.: SGSNA/25/SZ/00082U	P
5.1.3	Refer to 7.7.1 for further details to be included in the cell level test report		P
5.2	**Module**		P
5.2.1	The modules associated with the BESS that were tested shall be documented in the test report, including the generic (e. g., metallic or nonmetallic) enclosure material, the general layout of the module contents and the electrical configuration of the cells in the modules and the modules in the BESS.	Metallic enclosure	P
5.2.2	The module documentation included in the test report shall indicate if the modules associated with the BESS comply with UL 1973.	No related documentation was provided	N/A
5.2.3	Refer to 8.4 for further details to be included in the module level test report.		P
5.3	**Battery energy storage system unit**		P
5.3.1	The BESS unit documentation included in the test report shall indicate the units that comply with UL 9540 and include the manufacturer, model, electrical ratings, and energy capacity of all BESS.	No related documentation was provided	N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
5.3.2	For BESS units for which UL 9540 compliance cannot be determined, the documentation included in the test report shall include the number of modules in the BESS, electrical configuration of the module, and physical layout of the modules in the BESS, battery management system (BMS) and other major components of the BESS. The BESS enclosure overall dimensions and generic (e.g., metallic or nonmetallic) material used for the enclosure shall be documented. Depending upon the configuration of the BESS (e.g. the power conditioning system is external to the BESS enclosure), a battery system(s) can be tested as representative of the BESS. It shall be documented as to whether the battery system complies with UL 1973 in addition to the overall BESS compliance to UL 9540.	No related documentation was provided	N/A
5.3.3	If applicable, the details of any fire detection and suppression systems that are an integral part of the BESS shall be noted in the test report.	No fire detection and suppression systems are within unit	N/A
5.3.4	Refer to 9.7, 10.4 and 10.7 for further details to be included in the unit level and if applicable, installation level test reports.		P
5.4	**Flow Batteries**		N/A
5.4.1	For flow batteries, the report will cover the chemistry (e.g. vanadium redox, zinc bromine, etc.), a generic description of the electrolyte (s), the overall dimensions of the individual stack as well as the electrical rating in capacity and nominal voltage of the cell stack. The report will also include information on the complete flow battery system including the manufacturer's name and model number of the system, the electrical rating in volts and rated storage capacity in Ah or Wh, the number of cells and stacks in the system, and the maximum volume of electrolyte(s) for the system.		N/A
5.4.2	The flow battery documentation included in the test report shall indicate if the flow battery system complies with UL 1973.		N/A
5.4.3	See 7.7.2 for further details to be included in the flow battery cell level test report and 9.10 for further details to be included in the flow battery unit level test report.		N/A

PERFORMANCE

6.	**General**		P
6.1	The tests in this standard are extreme abuse conditions conducted on electrochemical energy storage devices that can result in fires, explosions,		P

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	smoke, off gassing of flammable and toxic materials, exposure to toxic and corrosive liquids, and potential exposure to hazardous voltages and electrical energy. See Annex B for recommended testing practices.		
6.2	At the conclusion of testing, samples shall be discharged in accordance with the manufacturer's specifications. All samples shall be disposed of in accordance with local regulations.		P
6.3	Temperatures on parts and surfaces shall be measured continuously, taking the average over every 60 seconds through the test with a thermocouple junction formed from 24-gauge or smaller, Type-K thermocouple wire unless noted otherwise in the specific test. The maximum of these averages shall be documented for each thermocouple location. Cell surface temperatures shall be measured continuously, but not averaged over every 60 seconds as the other temperature measurements are.		P
6.4	When heat flux measurements are taken, they shall be measured continuously, taking the average over every 60-second interval. The maximum of these averages shall be documented for each gauge location.		P
7	**Cell Level**		—
8	**Module Level**		—
9	**Unit Level**		P
9.1	**Sample and test configuration**		P
9.1.1	The unit level test shall be conducted with BESS units installed as described in the manufacturer's instructions and this section. Test configurations may include the following:		P
	a) Indoor floor mounted non-residential use BESS;		P
	b) Indoor floor mounted residential use BESS;		N/A
	c) Outdoor ground mounted non-residential use BESS;		P
	d) Outdoor ground mounted residential use BESS;		N/A
	e) Indoor wall mounted non-residential use BESS;		N/A
	f) Indoor wall mounted residential use BESS;		N/A
	g) Outdoor wall mounted non-residential use BESS;		N/A
	h) Outdoor wall mounted residential use BESS;		N/A

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	i) Rooftop non-residential use BESS;		N/A
	j) Rooftop residential use BESS; and		N/A
	k) Open parking garage non-residential use BESS installations.		N/A
9.1.2	The unit level test requires one initiating BESS unit, in which a thermal runaway condition resulting in cell to cell thermal runaway propagation in accordance with the module level test in 8.2.4 is initiated, and adjacent target BESS units representative of an installation. Tests conducted for indoor floor mounted installations for residential BESS may be considered representative of both indoor floor mounted and outdoor ground mounted installations with fire propagation hazards and separation distances between initiating and target units representative of the installation. Tests shall be conducted indoors with fire propagation hazards and separation distances between initiating and target units representative of the installation. The results of such tests for residential BESS may be considered to also represent an outdoor installation. Examples of potential test configurations are shown in Figure 9.1, Figure 9.2 and Figure 9.3.	See Attachment 4	P
	Exception: *Testing can be conducted outdoors for outdoor only installations if there are the following controls and environmental conditions in place:* *a) Wind screens are utilized with a maximum wind speed maintained at ≤ 12 mph;* *b) The temperature range is within 10°C to 40°C (50°F to 104°F);* *c) The humidity is < 90% RH;* *d) There is sufficient light to observe the testing;* *e) There is no precipitation during the testing;* *f) There is control of vegetation and combustibles in the test area to prevent any impact on the testing and to prevent inadvertent fire spread from the test area; and* *g) There are protection mechanisms in place to prevent inadvertent access by unauthorized persons in the test area and to prevent exposure of persons to any hazards as a result of testing.*		N/A
9.1.3	For outdoor non-residential use High Temperature Batteries installed in a container, the unit level test is waived as there is no additional information to be collected at the unit level for this technology when it is utilized for outdoor use only. Instead, the installation level test shall be conducted in accordance with 10.9.		N/A
9.1.4	9.1.4 For installations, where the high temperature battery modules are not installed on racks but rather within separate compartments within the container, the module is considered the test unit for the test of 10.9. See 10.2.3 and 10.2.4.		N/A
9.1.5	Depending upon the configuration and design of the BESS (e.g. the BESS is composed of multiple		P

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	separate parts within separate enclosures), this testing to determine fire characterization can be done at the battery system level. The suitability of this approach shall be determined based upon the overall design of the BESS and an analysis of the battery system as representative of the overall BESS for fire characterization concerns.		
9.1.6	Where the manufacturer's instructions indicate that the BESS can be installed outdoors and in open parking garages less than 3 m (10 feet) from the means of egress or other exposures, testing shall be conducted as described in this Section.		P
9.1.7	The initiating BESS unit shall contain components representative of a BESS unit in a complete installation. Combustible components that interconnect the initiating and target BESS units shall be included.	The initiating unit did not contain components representative of a BESS unit in a complete installation, provided by the manufacturer.	N/A
9.1.8	Target BESS units shall include the outer cabinet (if part of the design), racking, module enclosures, and components that retain cells components. The target BESS units may also include one live, populated module at the location of the highest anticipated temperature in the enclosure. The remaining target BESS unit module enclosures do not need to contain cells.	Target units included enclosures and modules. All modules in target units contained cells.	P
9.1.9	The initiating BESS unit shall be brought to the maximum operating state of charge (MOSOC), in accordance with the manufacturer's specifications and allowed to rest for a minimum of 1 hour at room ambient before the start of the test.	For initiating module (module 3): Charging method: Charge at constant power 27 kW, until voltage reaches 213 V or any cell reaches 3.65 V. Discharge method: Discharge at constant power 27 kW, until voltage reaches 162 V or any cell reaches 2.5 V. For other modules: Fully charged using the charging method: Charge at constant power 27 kW, until voltage reaches 213 V or any cell reaches 3.65 V.	P
9.1.10	Prior to initiating the test, the voltage of the initiating module shall be measured and recorded. If the voltage drop is greater than 0.1 % of the fully charged voltage of the module, then the initiating BESS shall be charged again as noted in 9.1.9 and the voltage of the initiating BESS shall be recorded.		P

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9.1.11	If a BESS unit includes an integral fire suppression system, there is an option of providing this with the DUT. If the BESS unit is provided with an optional integral fire suppression system, the system shall not be provided on the DUT.	An integral fire suppression system is optional. It was not provided on the DUT.	N/A
9.1.12	Electronics and software controls such as the battery management system (BMS) in the BESS are not relied upon for this testing. This does not include a fire suppression control in accordance with UL 864 that is external to the BESS, but provided as part of an integral fire suppression system per 9.1.11.		N/A
9.2	**Test method – Indoor floor mounted BESS units**		P
9.2.1	During an indoor test, the test room environment shall be controlled to prevent drafts that may affect test results. At the start of the test, the room ambient temperature shall not be less than 10°C (50°F) nor more than 32°C (90°F).		P
9.2.2	Any access door(s) or panels on the initiating BESS unit and adjacent target BESS units shall be closed, latched and locked at the beginning and duration of the test.		P
9.2.3	The initiating BESS unit shall be positioned adjacent to two instrumented wall sections.		P
9.2.4	Instrumented wall sections shall extend not less than 0.49 m (1.6 feet) horizontally beyond the exterior of the target BESS units.		P
9.2.5	Instrumented wall sections shall be at least 0.61-m (2- feet) taller than the BESS unit height, and not less than 2.13 m (7 feet) in height above the floor.		P
9.2.6	The surface of the instrumented wall sections shall be covered with gypsum wall board and painted flat black. An incremental visual reference shall be provided on the instrumented wall sections for scale so that flame extension can be accurately measured if applicable. The gypsum wall board shall be 13-mm (1/2-inch) thick at minimum.		P
9.2.7	The initiating BESS unit shall be centered underneath an appropriately sized smoke collection hood of an oxygen consumption calorimeter.		P
9.2.8	The light transmission in the calorimeter's exhaust duct shall be measured using a white light source and photo detector for the duration of the test, and the smoke release rate shall be calculated as described in 8.2.17.		P
9.2.9	The chemical and convective heat release rates shall be measured for the duration of the test, using the methodologies specified in 8.2.13 and 9.2.12, respectively.		P

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9.2.10	With reference to 9.2.9, the heat release rate measurement system shall be calibrated using an atomized heptane diffusion burner. The calibration shall be performed using flows of 3.8, 7.6, 11.4 and 15.2 L/min (1, 2, 3 and 4 gpm) of heptane.		P
9.2.11	With reference to 9.2.9, the convective heat release rate shall be measured using thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust system of the exhaust duct. See 9.2.12.		P
9.2.12	With reference to 9.2.9, the convective heat release rate shall be calculated using the following equation: $$HRR_c = V_e A \frac{353.22}{T_e} \int_{T_o}^{T} C_p dT$$		P
9.2.13	The physical spacing between BESS units (both initiating and target) and adjacent walls shall be representative of the intended installation as noted in 9.1.	See Attachment 4	P
9.2.14	Separation distances shall be specified by the manufacturer for distance between:		P
	a) The BESS units and the instrumented wall sections; and		P
	b) Adjacent BESS units.		P
9.2.15	Wall surface temperatures shall be measured in vertical array(s) at 152-mm (6-inch) intervals for the full height of the instrumented wall sections using No. 24-gauge or smaller, Type-K exposed junction thermocouples. The thermocouples for measuring the temperature on wall surfaces shall be horizontally positioned in the wall locations anticipated to receive the greatest thermal exposure from the initiating BESS unit. Temperatures shall be measured continuously, averaging over every 60-second interval per 6.3. The maximum of these averages shall be documented for each thermocouple location.		P
9.2.16	Thermocouples shall be secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires. The thermocouple tip shall be depressed into the gypsum so as to be flush with the gypsum surface at the point of measurement and held in thermal contact with the surface at that point by the use of pressure-sensitive paper tape.		P
9.2.17	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter or Gardon gauges at the surface of each instrumented wall as follows in (a) – (c). Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4. The maximum of		P

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	these averages shall be documented for each gauge location. a) Both are collinear with the vertical thermocouple array; b) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module; and c) One is positioned at the elevation estimated to receive the greatest heat flux during potential propagation of thermal runaway within the initiating BESS unit.		
	Exception: *If (b) and (c) are deemed to be at the same location based on a construction review, only one gauge is required.*		N/A
9.2.18	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter or Gardon gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit as follows in (a) and (b). Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4. The maximum of these averages shall be documented for each gauge location. a) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module within the initiating BESS; and b) One is positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.		P
	Exception: If (a) and (b) are deemed to be at the same location based on a construction review, only one gauge may be installed on the target unit for the measurement.		P
9.2.19	For BESS intended for installation outdoors or in open parking garages covered by 9.1.6, heat flux shall be measured with the sensing element of at least one water-cooled Schmidt-Boelter or Gardon gauge positioned at the mid height of the initiating unit at the minimum horizontal distance from the BESS specified by the manufacturer or the point where the majority of off-gas venting is expected from the initiating unit. Heat flux shall be measured continuously, averaging over every 60-second interval per 6.4.		
9.2.20	No. 24-gauge or smaller, Type-K exposed junction thermocouples shall be installed to measure the temperature of the surface proximate to the cells and between the cells and exposed face of the initiating module. Each non-initiating module enclosure within the initiating BESS unit shall be instrumented with at least one No. 24-gauge or smaller Type-K thermocouple(s) to provide data to monitor the thermal conditions within non-initiating modules. Additional thermocouples shall be placed to account		P

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	for convoluted enclosure interior geometries. Temperatures shall be measured continuously, averaging over every 60-second interval per 6.3. The maximum of these averages shall be documented for each thermocouple location.		
9.2.21	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator. The cheesecloth shall be untreated cotton cloth running 26 – 28 m^2/kg with a count of 28 – 32 threads in either direction within a 6.45 cm^2 (1 in^2) area.		N/A
9.2.22	Cell to cell thermal runaway propagation in accordance with the module level test in 8.2.4 shall be established within a single module in the initiating BESS unit: a) The position of the module shall be selected to present the greatest thermal exposure to adjacent modules (e.g. above, below, laterally), based on the results from the module level test; and b) The setup (i.e. type, quantity and positioning) of equipment for initiating thermal runaway in the module shall be the same as that used to initiate and propagate thermal runaway within the module level test (Section 8).		P
9.2.23	The composition, velocity and temperature of the initiating BESS unit vent gases shall be measured within the calorimeter's exhaust duct as outlined in 8.2.12. The hydrocarbon content of the vent gas shall be measured using flame ionization detection. Hydrogen gas shall be measured with a palladium-nickel thin-film solid state analyzer. Composition, velocity and temperature instrumentation shall be collocated with heat release rate calorimetry instrumentation.		P
9.2.24	At the request of the BESS manufacturer, the hydrocarbon content of the vent gas may additionally be measured using a Fourier-Transform Infrared Spectrometer with a minimum resolution of 1 cm^{-1} and a path length of at least 2.0 m (6.6 feet), or equivalent gas analyzer.		P
9.2.25	The test shall be terminated if:		P
	a) There are three consecutive temperature readings measured inside each module within the initiating BESS unit that are determined to be falling over 15-minute intervals;		P
	b) The modules return to a temperature less than 60 °C (140 °F);		P
	c) The fire propagates to adjacent units or to adjacent walls;		N/A

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	d) A condition hazardous to test staff or the test facility requires mitigation; or		N/A
	e) Flaming outside the test room is observed.		N/A
9.2.26	For residential use systems, the gas collection data gathered in 9.2 shall be compared to the smallest room installation specified by the manufacturer to determine if the flammable gas collected exceeds 25% LFL in air.		N/A
9.3	**Test method – Outdoor ground mounted units**		P
9.3.1	Outdoor ground mounted non-residential use BESS being evaluated for installation in close proximity to buildings and structures shall use the test method described in 9.2. If intended for outdoor use only installations, including rooftop installations, the smoke release rate, the convective and chemical heat release rate and content, velocity and temperature of the released vent gases need not be measured.		P
9.3.2	Outdoor ground mounted residential use BESS being evaluated for installation in close proximity to buildings and structures shall use the test method described in Section 9.2 except as noted in 9.3.3 and 9.3.4. If intended for outdoor use only installations, the smoke release rate, the convective and chemical heat release rate and content, velocity, and temperature of the released vent gases need not be measured.		N/A
9.3.3	Test samples shall be installed as shown in Figure 9.2 in proximity to an instrumented wall section that is 3.66-m (12-feet) tall with a 0.3-m (1-foot) wide horizontal soffit (undersurface of the eave shown in Figure 9.2). The sample shall be mounted on a support substrate and spaced from the wall in accordance with the minimum separation distances specified by the manufacturer. The wall and soffit shall be constructed with 19.05-mm (3/4-inch) plywood installed on wood studs and painted flat black. The instrumented wall shall extend not less than 0.49-m (1.6-feet) horizontally beyond the exterior of the target BESS units. The No. 24-gauge or smaller, Type-K exposed junction thermocouple array on the walls as noted in 9.2.15 shall extend to the surface of the soffit as shown in Figure 9.2.		P
	Exception: *If the manufacturer requires installation against non-flammable material, the test setup may include manufacturer recommended backing material between the unit and plywood wall.*		N/A
9.3.4	Target BESS shall be installed on each side of the initiating BESS in accordance with the manufacturer's installation specifications. The physical spacing between BESS units (both initiating		P

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	and target) shall be the minimum separation distances specified by the manufacturer.		
9.4	**Test Method – Indoor wall mounted units**		N/A
9.4.1	Testing of indoor wall mounted BESS shall be in accordance with Section 9.2, except as modified in this section. See Figure 9.3.		N/A
9.4.2	BESS intended for wall mount installations shall only be tested using instrumented wall sections not less than 2.44 m (8 feet) in height and width, and with a 0.3-m (1-foot) wide horizontal ceiling as shown in Figure 9.3. The walls and ceiling shall be constructed with gypsum wall board installed on wood studs and painted flat black. The gypsum wall board shall be 13-mm (1/2-inch) thick at minimum. The instrumented wall shall extend not less than 0.49-m (1.6-feet) horizontally beyond the exterior of the target BESS units. The No. 24-gauge or smaller, Type-K exposed junction thermocouple array on the walls shall extend to the surface of the ceiling as shown in Figure 9.3.		N/A
9.4.3	When BESS are tested in accordance with 9.4.2, the initiating BESS unit shall be positioned with the center located 1.22-m (4-feet) above the floor or at a height in accordance with the manufacturer's installation instructions, and halfway between adjacent walls.		N/A
9.4.4	Target BESS shall be installed on the wall on each side of the initiating BESS, at the same height above the floor as the initiating BESS. The physical spacing between BESS units (both initiating and target) shall be the minimum separation distances specified by the manufacturer.		N/A
9.4.5	The wall on which the initiating and target BESS units are mounted shall be instrumented in accordance with 9.2.		N/A
9.4.6	The gas collection methods shall be in accordance with 9.2. For residential use systems, the gas collection data gathered in 9.2 shall be compared to the smallest room installation specified by the manufacturer to determine if the flammable gas collected exceeds 25% LFL in air.		N/A
9.4.7	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator. The cheesecloth shall be untreated cotton cloth running 26 – 28 m^2/kg with a count of 28 – 32 threads in either direction within a 6.45 cm^2 (1 in^2) area.		N/A
9.5	**Test Method – Outdoor wall mounted units**		N/A
9.5.1	Testing of outdoor wall mounted residential and non-residential BESS shall be in accordance with 9.2,		N/A

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	except as modified in this section. See Figure 9.3. If intended for outdoor use only wall mount installations, the smoke release rate, the convective and chemical heat release rate; and the content, velocity and temperature of the released vent gases need not be measured. Heat flux measurements for the accessible means of egress or in front of the BESS shall be measured in accordance with 9.2.19.		
9.5.2	Test samples shall be mounted on an instrumented wall section that is a minimum of 3.66-m (12-feet) tall with a 0.3-m (1-foot) wide horizontal soffit (undersurface of the eave shown in Figure 9.3). The wall and soffit shall be constructed with 19.05-mm (3/4-inch) plywood installed on wood studs and painted flat black. An optional substrate of 13-mm (1/2-inch) or 16-mm (5/8-inch) exterior gypsum sheathing shall be permitted to be installed on the plywood. The instrumented wall shall extend not less than 0.49-m (1.6-feet) horizontally beyond the exterior of the target BESS units. The No. 24-gauge or smaller, Type-K exposed junction thermocouple array on the walls as noted in 9.2.15 shall extend to the surface of the soffit as shown in Figure 9.3.		N/A
	Exception: *If the manufacturer requires installation against non-flammable material, the test setup may include manufacturer recommended backing material between the unit and plywood wall.*		N/A
9.5.3	The initiating BESS unit shall be positioned on the instrumented wall, with its center located 1.22-m (4-feet) above the floor, and halfway between wall edges.		N/A
9.5.4	Target BESS shall be installed on the wall on each side of the initiating BESS, at the same height above the floor as the initiating BESS. The physical spacing between BESS units (both initiating and target) shall be the minimum separation distances specified by the manufacturer.		N/A
9.5.5	The wall on which the initiating and target BESS units are mounted, and the soffit in the case of residential use BESS, shall be instrumented in accordance with 9.2.		N/A
9.5.6	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator. The cheesecloth shall be untreated cotton cloth running 26 – 28 m^2/kg with a count of 28 – 32 threads in either direction within a 6.45 cm^2 (1 in^2) area.		N/A
9.6	**Rooftop and open parking garage installations**		N/A
9.6.1	Testing of BESS intended for non-residential use rooftop or open parking garage installations shall be in accordance with 9.2.		N/A

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9.6.2	If intended for rooftop and open parking garage use only installations, the smoke release rate, the convective and chemical heat release rate and content, velocity and temperature of the released vent gases need not be measured.		N/A
9.6.3	BESS intended for installation on combustible roofs shall be mounted on constructed with 13-mm (1/2-inch) gypsum wall board painted flat black, or the mounting surface recommended by the manufacturer, also painted flat black.		N/A
9.6.4	Temperatures on the surface of the combustible roof assembly shall be measured under the center of the BESS and in horizontal array(s) at 152-mm (6-inch) intervals for a minimum 1 m (3.3 feet) from the edge of the initiating BESS unit using No. 24-gauge or smaller, Type-K exposed junction thermocouples. The thermocouples for measuring the temperature on roof surfaces shall be positioned in the roof locations anticipated to receive the greatest thermal exposure from the initiating BESS unit.		N/A
9.6.5	If the BESS is intended to be installed on combustible roof assemblies beneath PV panels, combustible materials, or other obstructions, the test shall be conducted with the ESS mounted underneath the obstructions, as specified by the manufacturer. The type of overhead obstruction used in the test shall be that which is anticipated to provide the greatest fire challenge. The vertical distances between the rooftop and the ESS, and between the ESS and the overhead obstruction shall be the minimum specified by the manufacturer. The overhead obstruction shall extend horizontally a minimum 2 m (6.6 feet) in all directions from the edges of the target BESS, unless lesser distances are specified by the manufacturer's installation instructions.		N/A
9.7	**Unit level test report**		P
9.7.1	The report on the unit level testing shall identify the type of installation being tested, as follows:		P
	a) Indoor floor mounted non-residential use BESS;		P
	b) Indoor floor mounted residential use BESS;		N/A
	c) Outdoor ground mounted non-residential use BESS;		P
	d) Outdoor ground mounted residential use BESS;		N/A
	e) Indoor wall mounted non-residential use BESS;		N/A
	f) Indoor wall mounted residential use BESS;		N/A
	g) Outdoor wall mounted non-residential use BESS;		N/A
	h) Outdoor wall mounted residential use BESS;		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	i) Rooftop installed non-residential use BESS; or		N/A
	j) Open parking garage installed non-residential use BESS.		N/A
9.7.2	With reference to 9.7.1, if testing is intended to represent more than one installation type, this shall be noted in the report.	Indoor floor mounted non-residential use BESS, Outdoor ground mounted non-residential use BESS	P
9.7.3	The report shall include the following, as applicable:		P
	a) Unit manufacturer name and model number (and whether UL 9540 compliant);	Unit manufacturer name: Huawei Digital Power Technologies Co., Ltd. Model number: LUNA2000-241-2S1 No related documentation for UL 9540 was provided	P
	b) Number of modules in the initiating BESS unit;	4	P
	c) The construction of the initiating BESS unit per 5.3;	See Attachment 1	P
	d) Fire protection features / detection / suppression systems within unit;		N/A
	e) Module voltage(s) corresponding to the tested SOC;	See Table 1	P
	f) The thermal runaway initiation method used;	See Table 1	P
	g) Location of the initiating module within the BESS unit;	See Attachment 4	P
	h) Diagram and dimensions of the test setup including mounting location of the initiating and target BESS units, and the locations of walls, ceilings, soffits as applicable, and thermocouples;	See Attachment 4	P
	i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension;	No flaming during the test	P
	j) Chemical and convective heat release rate versus time data;	See Attachment 8 and 10	P
	k) Separation distances from the initiating BESS unit to target walls (e. g. distances A and C in Figure 9.1) and target heat flux gauges;	See Attachment 4	P
	l) Separation distances from the initiating BESS unit to target BESS units (e.g. distances D and H in Figure 9.1);	See Attachment 4	P
	m) The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple; NOTE: The maximum target BESS temperature is averaged over 60 seconds.	See Table 3 and Attachment 4 and 6	P

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	n) The maximum ceiling or soffit surface temperatures achieved during the indoor or outdoor wall mounted test and the location of the measuring thermocouple;		N/A
	o) The maximum incident heat flux on target wall surfaces and target BESS units;	Target wall surfaces: 0 kW/m^2 Target BESS unit: 0 kW/m^2	P
	p) The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test;		N/A
	q) Gas generation and composition data if conducted indoors;	See Table 2 and Attachment 7	P
	r) Peak smoke release rate and total smoke release data if conducted indoors;	See Attachment 9, 10	P
	s) Indication of the activation of integral fire protection systems and if activated the time into the test at which activation occurred;	No fire detection and suppression systems are within unit	N/A
	t) Observation of flying debris or explosive discharge of gases unless mitigated by an engineered deflagration protection system;	No observation of flying debris or explosive discharge of gases	P
	u) Observation of re-ignition(s) from thermal runaway events;	No observation of re-ignition(s)	P
	v) Observation(s) of sparks, electrical arcs, or other electrical events;	No observation of sparks, electrical arcs, or other electrical events	P
	w) Observations of the damage to: 1) The initiating BESS unit; 2) Target BESS units; 3) Adjacent walls, ceilings, or soffits;	See Attachment 5 1) The initiating cell (Cell 23) and other cells (Cell 24 and Cell 25) occurred thermal runaway in the initiating module; 2) No damage to target BESS units; 3) No damage to adjacent walls, ceilings, or soffits.	P
	x) Photos and video of the test;		P
	y) If the test is terminated in accordance with 9.2.25, the circumstances of the termination; and		P
	z) Module level test report summary and cell level test report summary.	See summary of testing	P
9.8	**Performance at unit level testing**		P
9.8.1	Installation level testing in Section 10 is not required if the following performance conditions outlined in Table 9.1 are met during the unit level test.		P

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
Table 9.1 Unit Level Performance Criteria			P
Non-Residential Installations:			P
Indoor Floor Mounted	a) Flaming outside the initiating BESS unit is not observed; b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; d) Explosion hazards are not observed, including deflagration or detonation.	a) No flaming outside the initiating BESS unit was observed b) The maximum temperature of target modules within the target BESS units adjacent to the initiating BESS unit is 23.2 °C c) The maximum temperature of wall surface is 21.1 °C d) No explosion hazards were observed	P
Outdoor Ground Mounted	a) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; b) For BESS units intended for installation near exposures, surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; c) Explosion hazards are not observed, including deflagration or detonation; and d) Heat flux measured at the minimum distance to a means of egress specified by the manufacturer shall not exceed 1.3 kW/m^2.	a) The maximum temperature of target modules within the target BESS units adjacent to the initiating BESS unit is 23.2 °C b) The maximum temperature of wall surface is 21.1 °C c) No explosion hazards were observed d) Heat flux measured at the minimum distance to a means of egress specified by the manufacturer is 0.007 kW/m^2	P
Indoor Wall Mounted	a) Flaming outside the initiating BESS unit is not observed; b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; and d) Explosion hazards are not observed, including deflagration or detonation.		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
Outdoor Wall Mounted	a) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; b) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; c) Explosion hazards are not observed, including deflagration or detonation; and d) Heat flux measured at the minimum distance to a means of egress specified by the manufacturer shall not exceed 1.3 kW/m^2.		N/A
Rooftop and Open Parking Garages	a) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; b) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; c) For BESS units intended for installation on combustible roof constructions, surface temperature measurements on roof surfaces do not exceed 97 °C (175 °F) temperature rise above ambient per 9.6.5; d) Explosion hazards are not observed, including deflagration or detonation; and e) For BESS units intended for installation in open parking garages, heat flux measured at the distance from the BESS to the means of egress shall not exceed 1.3 kW/m^2.		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
Residential Installations:			N/A
Indoor Floor Mounted	a) Charring or ignition of the cheesecloth indicator is not observed; b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; d) Explosion hazards are not observed, including deflagration or detonation; and e) The concentration of flammable gas does not exceed 25% LFL in air for the smallest specified room installation size.		N/A
Outdoor Ground Mounted	a) Flaming outside the initiating BESS unit is not observed. b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) For BESS units intended for near exposures, surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; d) Explosion hazards are not observed, including deflagration or detonation; and e) Heat flux measured at the minimum distance to a means of egress shall not exceed 1.3 kW/m^2.		N/A
Indoor Wall Mounted	a) Flaming outside the initiating BESS unit is not observed as demonstrated by no flaming or charring of the cheesecloth indicator; b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; d) Explosion hazards are not observed, including deflagration or detonation; and e) The concentration of flammable gas does not exceed 25% LFL for the smallest intended room installation size.		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
Outdoor Wall Mounted	a) Charring or ignition of the cheesecloth indicator is not observed; b) Surface temperatures of modules within the target BESS units adjacent to the initiating BESS unit do not exceed the temperature at which thermally initiated cell venting occurs, as determined in 7.3.1.10; c) Surface temperature measurements on wall surfaces do not exceed 97 °C (175 °F) of temperature rise above ambient; d) Explosion hazards are not observed, including deflagration or detonation; and e) Heat flux measured at the minimum distance to a means of egress shall not exceed 1.3 kW/m^2.		N/A

9.9	**Flow battery unit tests**		N/A
9.9.1	For those flow battery systems that do not meet the performance criteria of 7.9, unit level test using a test battery representative of the complete flow battery system but at a scale small enough to fit under the smoke collection hood of the calorimeter.		N/A
9.9.2	The test flow battery system shall be subjected to each of the following tests while monitoring the temperature of the electrolyte at a location in the fluid system that is anticipated to be the hottest. Where test data is not already available from UL 1973 testing, the test methods referenced below shall be applied and incorporated into this test Standard:		N/A
	a) The Overcharge Test in accordance with the Performance Electrical Tests of UL 1973;		N/A
	b) The High Rate Charge test in accordance with the Performance Electrical Tests of UL 1973; and		N/A
	c) The Short Circuit Test in accordance with the Performance Electrical Tests of UL 1973.		N/A
	NOTE: The electrolyte from the outlet of the stacks or within the stacks would be an appropriate location for sampling the temperature during these tests.		N/A
9.9.3	If the temperatures of the electrolytes during the tests of 9.9.2 do not exceed the flashpoint temperature determined in 7.3.2.1.2 the testing is concluded at the unit level. If the temperatures of the electrolytes during the tests of 9.9.2 exceed the flashpoint temperature determined during 7.3.2.1.2, the flow battery system is considered noncompliant and would need to be revised and retested.		N/A
9.9.4	The volume of flammable gases measured during the testing shall be scaled to the maximum energy		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	reservoir for the intended flow battery system in order to determine the potential total flammable gas that can be produced by the system under a fault condition that leads to off gassing. This information shall be provided in the report. The gas data collected can be scaled to the largest representative system.		
9.10	**Flow battery unit level test report**		N/A
9.10.1	The report on flow battery unit testing shall include the following:		N/A
	a) Flow battery system manufacturer name and model number (and whether UL 1973 compliant);		N/A
	b) System Cell stack details per 5.4;		N/A
	c) Energy storage technology (and whether UL 9540 compliant);		N/A
	d) The rated energy storage capacity of the flow battery (e.g. Ampere-hours or Watt-hours);		N/A
	e) Electrolyte(s) composition and maximum quantity in the systems;		N/A
	f) Test cell stack details per 5.4;		N/A
	g) Electrolyte quantities in the representative test flow battery system;		N/A
	h) Maximum charge voltage and charge current during the overcharge test;		N/A
	i) External short circuit resistance applied and maximum short-circuit current measured during the short circuit test;		N/A
	j) Flash point temperatures determined for each charged electrolyte (if applicable);		N/A
	k) Maximum electrolyte temperature measured during the overcharge tests;		N/A
	l) Maximum electrolyte temperature measured during the short circuit test;		N/A
	m) Maximum electrolyte temperature measured during the High Rate Charge test;		N/A
	n) Volume of gas measured with representative test flow battery system and scaled volume of gas based on full-size flow battery system;		N/A
	o) Observation(s) of flying debris or explosive discharge of gases;		N/A
	p) Observation(s) of sparks, electrical arcs, or other electrical events; and		N/A
	q) Video of the test.		N/A
9.11	**Flow battery unit level performance criteria**		N/A
9.11.1	The flow battery performance level criteria is met if:		N/A

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UNIT LEVEL			
Clause	Requirement + Test	Result – Remark	Verdict
	a) The flash point temperature(s) measured in the test of 7.3.2.1.2 exceed the maximum temperature measured on the energy reservoir during each of the tests of 9.9.2 by at least 5 °C (9 °F); and		N/A
	b) For flow battery systems with two electrolytes, the flash point temperature(s) measured in the test of 7.3.2.1.2 exceed the maximum temperature of the mixed solution measured in accordance with 7.3.2.2.2 by at least 5 °C (9 °F).		N/A

10	**Installation Level**	—

ANNEX A	**Test Concepts And Application Of Test Results To Installations** (informative)		—
A1	Introduction		N/A
A2	Test Methodology and Purpose		N/A
A3	Evaluating the Results		N/A

ANNEX B	**Safety Recommendations for Testing** (informative)		P
B1	General		P

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UNIT LEVEL

UNIT LEVEL TEST RESULT:

Table 1: Thermal runaway test result	
Summary of initiating module	
Initial ambient temperature:	23.9 °C
Initial relative humidity:	28 % RH
Pre-conditioning time	From 2025-11-14 20:03:06 to 2025-11-15 15:22:44
Thermal runaway test start time (heating start time)	2025-11-18 16:05:27
Module voltage before test:	202.54 V
Methods used to initiate thermal runaway	Heating the cell with externally applied flexible film heaters that cover two wider side surfaces of the cell
Average heating rate:	5.0 °C/min (Thermocouple number: Cell 23-1 and Cell 23-3)
Surface temperature at which gases were first vented:	150.2 °C (Thermocouple number: Cell 23-2)
Time when gases were first vented:	2025-11-18 16:49:46
Surface temperature prior to thermal runaway:	177.7 °C (Thermocouple number: Cell 23-2)
Time when thermal runaway:	2015-11-18 16:58:51
Module voltage after test:	191.69 V
Location of cell(s) for initiating thermal runaway	Cell 23 (see Attachment 2)
Thermal runaway of other cells within module:	Cell 24 and Cell 25 (see Attachment 2)
Observation(s) of flying debris:	No observation of flying debris
Observation(s) of explosive discharge of gas:	No observation of explosive discharge of gas
Observation(s) of sparks, electrical arcs or other electrical events:	No observation of sparks, electrical arcs or other electrical events
Locations and visual estimations of flame	N/A (No flame during test)
Module weight before test:	417.0 kg
Module weight after test:	414.0 kg
Module weight loss:	3.0 kg
Summary of other modules	
Status of other modules	No thermal runaway observed
Supplementary information:	N/A

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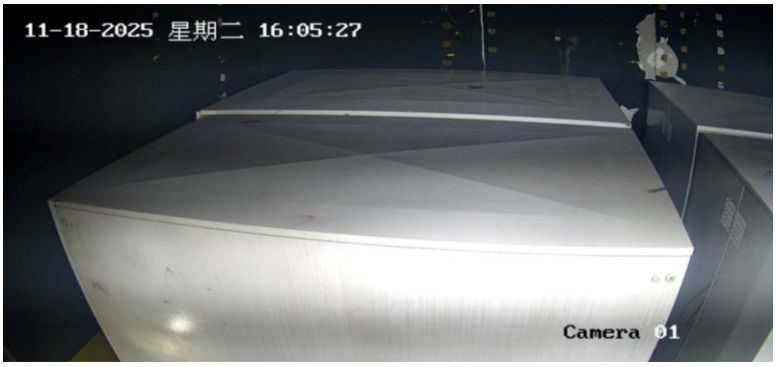
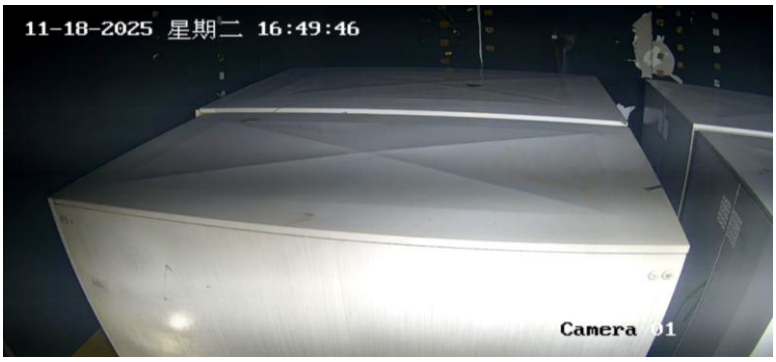
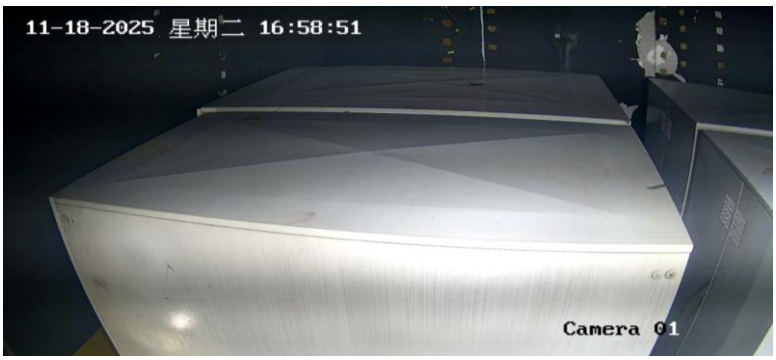
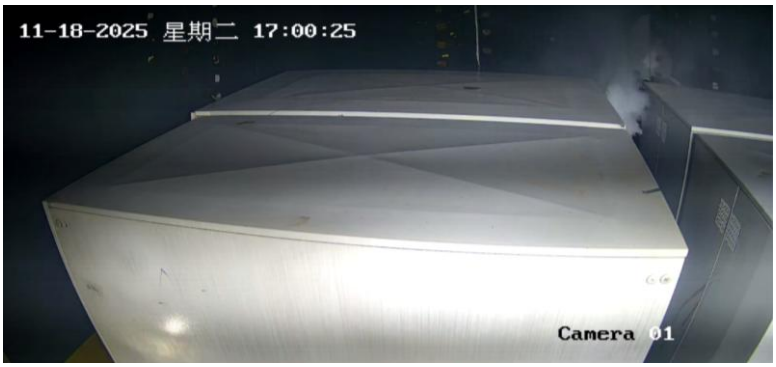
UNIT LEVEL

Timeline of thermal runaway

Time (hh:mm:ss)	Event	Description
2025-11-18 16:05:27	Start testing	
2025-11-18 16:49:46	The initiating cell (Cell 23) vented	
2015-11-18 16:58:51	Cell 23: Thermal runaway happened	
2025-11-18 17:00:25	Cell 24: Thermal propagation happened	

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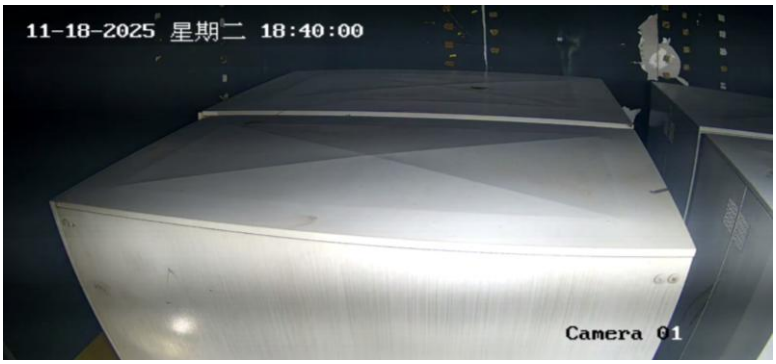
UNIT LEVEL		
2025-11-18 17:09:28	Cell 25: Thermal propagation happened	
2025-11-18 18:40:00	No smoke released	
Remark: Refer to attachment 4 for details of sample before test and test setup with thermocouple location		

Table 2: Vented gas composition result				
Composition	Chemical formula	Measurement peak (L/s)	Measurement (L)	Analysis Method
Carbon monoxide	CO	0.0350	1.0700	FTIR
Carbon dioxide	CO_2	0.1951	65.1343	FTIR
Methane	CH_4	0.0257	1.1450	FTIR
Acetylene	C_2H_2	0.0031	0.2016	FTIR
Ethene	C_2H_4	0.0209	0.5459	FTIR
Methanol	CH_4O	0.0046	0.0307	FTIR
Dimethyl carbonate	$C_3H_6O_3$	0.0163	0.4843	FTIR
Methanal	HCHO	0.0030	0.1258	FTIR
Total Hydrocarbons	(Propane Equivalent)	-	61.712	FID
Flow rate in exhaust duct (m^3/s)		2.5		
Sampling frequency of FTIR (Hz)		0.1		

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Table 3: Monitored temperature result			
Thermocouple number	Thermocouple location	Measured maximum temperature, °C	Limit, °C
Cell 23-1	Center of the cell 23, the cell surface temperature of widest side 1, near cell 24	670.5	-
Cell 23-2	Surface of the cell 23, not covered by film heater, the cell surface temperature of widest side 1, near cell 24	546.7	-
Cell 23-3	Center of the cell 23, the cell surface temperature of widest side 2, near cell 22	693.7	-
Cell 23-4	Between the cell vent and positive terminal of cell 23	468.7	-
Cell 38-1	Center of the cell 38, the cell surface temperature of widest side 2, near cell 39	140.5	-
Cell 38-2	Surface of the cell 38, not covered by film heater, the cell surface temperature of widest side 2, near cell 39	130.8	-
Cell 38-3	Center of the cell 38, the cell surface temperature of widest side 1, near cell 37	655.2	-
Cell 38-4	Between the cell vent and positive terminal of cell 38	124.4	-
Cell 7	Center of the cell 7, the cell surface temperature of widest side 1, near cell 6	131.0	-
Cell 8	Center of the cell 8, the cell surface temperature of widest side 1, near cell 7	127.6	-
Cell 16	Center of the cell 16, the cell surface temperature of widest side 2, near the enclosure	35.4	-
Cell 17	Center of the cell 17, the cell surface temperature of widest side 2, near cell 16	40.3	-
Cell 20	Center of the cell 20, the cell surface temperature of widest side 2, near cell 19	58.6	-
Cell 21	Center of the cell 21, the cell surface temperature of widest side 2, near cell 20	75.0	-
Cell 22-1	Center of the cell 22, the cell surface temperature of widest side 2, near cell 21	133.1	-
Cell 22-2	Center of the cell 22, the cell surface temperature of widest side 1, near cell 23	278.7	-
Cell 24-1	Center of the cell 24, the cell surface temperature of widest side 2, near cell 23	680.2	-
Cell 24-2	Center of the cell 24, the cell surface temperature of widest side 1, near cell 25	565.1	-
Cell 25	Center of the cell 25, the cell surface temperature of widest side 1, near cell 26	419.0	-

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Cell 31	Center of the cell 31, the cell surface temperature of widest side 1, near the enclosure	61.5	-
Cell 32	Center of the cell 32, the cell surface temperature of widest side 1, near cell 31	205.2	-
Cell 35	Center of the cell 35, the cell surface temperature of widest side 1, near cell 34	68.1	-
Cell 36	Center of the cell 36, the cell surface temperature of widest side 1, near cell 35	93.3	-
Cell 37-1	Center of the cell 37, the cell surface temperature of widest side 1, near cell 36	330.7	-
Cell 37-2	Center of the cell 37, the cell surface temperature of widest side 2, near cell 38	114.0	-
Cell 39-1	Center of the cell 39, the cell surface temperature of widest side 1, near cell 38	116.6	-
Cell 39-2	Center of the cell 39, the cell surface temperature of widest side 2, near cell 40	59.4	-
Cell 40	Center of the cell 40, the cell surface temperature of widest side 2, near cell 41	227.6	-
Cell 52	Center of the cell 52, the cell surface temperature of widest side 2, near cell 51	212.7	-
Cell 53	Center of the cell 53, the cell surface temperature of widest side 2, near cell 52	50.8	-
Module 1 of initiating unit	The center and bottom of the enclosure, module 1, initiating unit	25.3	-
Module 2 of initiating unit	The center and bottom of the enclosure, module 2, initiating unit	161.9	-
Module 4 of initiating unit	The center and top of the enclosure, module 4, initiating unit	41.2	-
Top_Module 3	The center and top of the enclosure, module 3, initiating unit	184.8	-
Bottom_Module 3	The center and bottom of the enclosure, module 3, initiating unit	65.6	-
Left_Module 3	The center and left of the enclosure, module 3, initiating unit	79.0	-
Right_Module 3	The center and right of the enclosure, module 3, initiating unit	86.4	-
Front_Module 3	The center and front of the enclosure, module 3, initiating unit	32.1	-
Back_Module 3	The center and back of the enclosure, module 3, initiating unit	87.3	-
Back_Initiating unit	The center and back of the enclosure, initiating unit	20.3	-
Front_Initiating unit	The center and front of the enclosure, initiating unit	23.0	-

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UNIT LEVEL			
Right_Initiating unit	The center and right of the enclosure, initiating unit	20.5	-
Left_Initiating unit	The center and left of the enclosure, initiating unit	20.1	-
Top_Initiating unit	The center and top of the enclosure, initiating unit	20.7	-
Top_Initiating unit_Inner	The center and top of the inner enclosure, initiating unit	23.5	-
Bottom_Initiating unit_Inner	The center and bottom of the inner enclosure, initiating unit	21.3	-
Bottom_Initiating unit	The center and bottom of the enclosure, initiating unit	22.2	-
Module 1 of target unit 1	The center and right of the enclosure, module 1, target unit 1	23.2	169.8
Module 2 of target unit 1	The center and right of the enclosure, module 2, target unit 1	23.2	169.8
Module 3 of target unit 1	The center and right of the enclosure, module 3, target unit 1	23.0	169.8
Module 4 of target unit 1	The center and right of the enclosure, module 4, target unit 1	22.6	169.8
Right_Target unit 1	The center and right of the enclosure, target unit 1	20.4	-
Module 1 of target unit 2	The center and back of the enclosure, module 1, target unit 2	22.8	169.8
Module 2 of target unit 2	The center and back of the enclosure, module 2, target unit 2	22.4	169.8
Module 3 of target unit 2	The center and back of the enclosure, module 3, target unit 2	21.4	169.8
Module 4 of target unit 2	The center and back of the enclosure, module 4, target unit 2	20.2	169.8
Back_Target unit 2	The center and back of the enclosure, target unit 2	21.8	-
Module 1 of target unit 3	The center and right of the enclosure, module 1, target unit 3	22.1	169.8
Module 2 of target unit 3	The center and right of the enclosure, module 2, target unit 3	22.8	169.8
Module 3 of target unit 3	The center and right of the enclosure, module 3, target unit 3	22.5	169.8
Module 4 of target unit 3	The center and right of the enclosure, module 4, target unit 3	22.6	169.8
Right_Target unit 3	The center and right of the enclosure, target unit 3	19.0	-
AT	The temperature of ambient	24.0	-
Wall 1-1	Wall 1 surface 1	18.9	120.9
Wall 1-2	Wall 1 surface 2	19.4	120.9

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UNIT LEVEL			
Wall 1-3	Wall 1 surface 3	19.0	120.9
Wall 1-4	Wall 1 surface 4	19.2	120.9
Wall 1-5	Wall 1 surface 5	19.5	120.9
Wall 1-6	Wall 1 surface 6	19.7	120.9
Wall 1-7	Wall 1 surface 7	19.8	120.9
Wall 1-8	Wall 1 surface 8	19.8	120.9
Wall 1-9	Wall 1 surface 9	20.0	120.9
Wall 1-10	Wall 1 surface 10	20.0	120.9
Wall 1-11	Wall 1 surface 11	20.4	120.9
Wall 1-12	Wall 1 surface 12	20.5	120.9
Wall 1-13	Wall 1 surface 13	20.5	120.9
Wall 1-14	Wall 1 surface 14	20.7	120.9
Wall 1-15	Wall 1 surface 15	20.7	120.9
Wall 1-16	Wall 1 surface 16	20.8	120.9
Wall 1-17	Wall 1 surface 17	20.8	120.9
Wall 1-18	Wall 1 surface 18	20.8	120.9
Wall 2-1	Wall 2 surface 1	19.4	120.9
Wall 2-2	Wall 2 surface 2	19.4	120.9
Wall 2-3	Wall 2 surface 3	19.5	120.9
Wall 2-4	Wall 2 surface 4	19.5	120.9
Wall 2-5	Wall 2 surface 5	19.6	120.9
Wall 2-6	Wall 2 surface 6	19.9	120.9
Wall 2-7	Wall 2 surface 7	20.3	120.9
Wall 2-8	Wall 2 surface 8	20.1	120.9
Wall 2-9	Wall 2 surface 9	20.2	120.9
Wall 2-10	Wall 2 surface 10	20.0	120.9
Wall 2-11	Wall 2 surface 11	20.6	120.9
Wall 2-12	Wall 2 surface 12	20.7	120.9
Wall 2-13	Wall 2 surface 13	20.7	120.9
Wall 2-14	Wall 2 surface 14	21.0	120.9
Wall 2-15	Wall 2 surface 15	21.0	120.9
Wall 2-16	Wall 2 surface 16	21.1	120.9
Wall 2-17	Wall 2 surface 17	21.0	120.9
Wall 2-18	Wall 2 surface 18	21.0	120.9
Wall 2-19	Wall 2 surface 19	20.8	120.9
Wall 2-20	Wall 2 surface 20	20.8	120.9
Wall 2-21	Wall 2 surface 21	20.7	120.9
Wall 2-22	Wall 2 surface 22	20.7	120.9

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UNIT LEVEL			
Wall 2-23	Wall 2 surface 23	20.6	120.9
Wall 2-24	Wall 2 surface 24	20.6	120.9
Remark: please see Attachment 4 for thermocouple locations and Attachment 6 for monitored temperature charts.			

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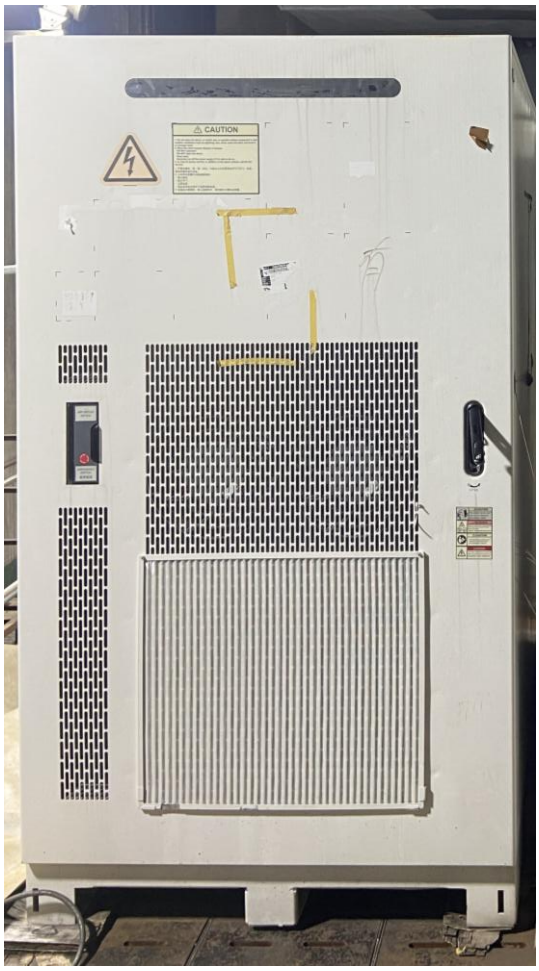
Attachment 1: Product description

The Smart String ESS, model: LUNA2000-241-2S1 consists of 4 pcs battery modules, model: LUNA2000-60-2E1 connected in 4S.



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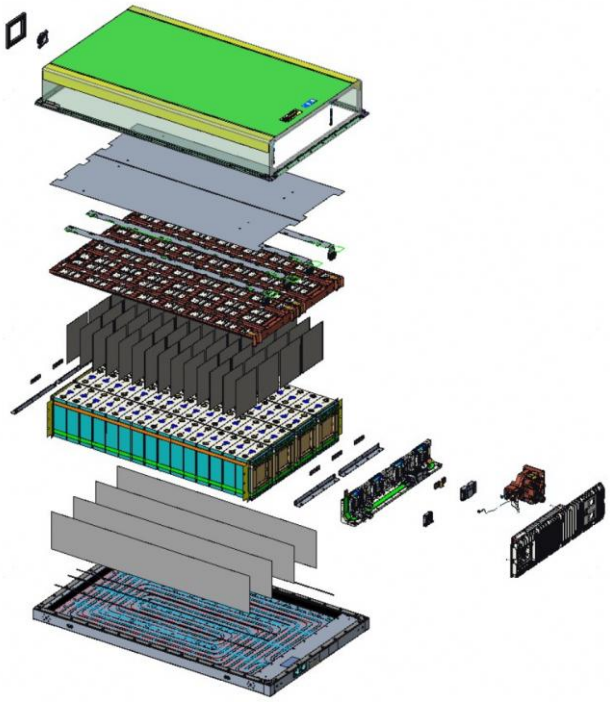
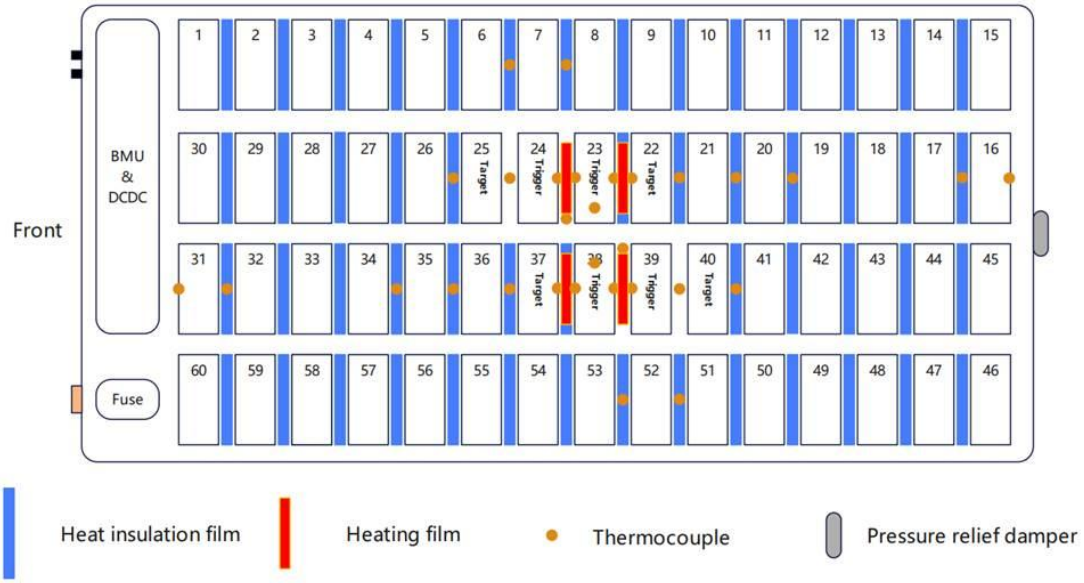
Attachment 2: Exploding drawing of module & Identification/location of cells within the module

Exploding drawing of module as below:



Identification/location of cells within the module as below:



Remark: Cell 23 is the initiating cell. The heat insulation films between Cell 23 and Cell 24, Cell 24 and Cell 25, Cell 38 and Cell 39, Cell 39 and Cell 40 were removed. The heating films attached to Cell 38 were not used during the test.

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Attachment 3: Pre-conditioning profile

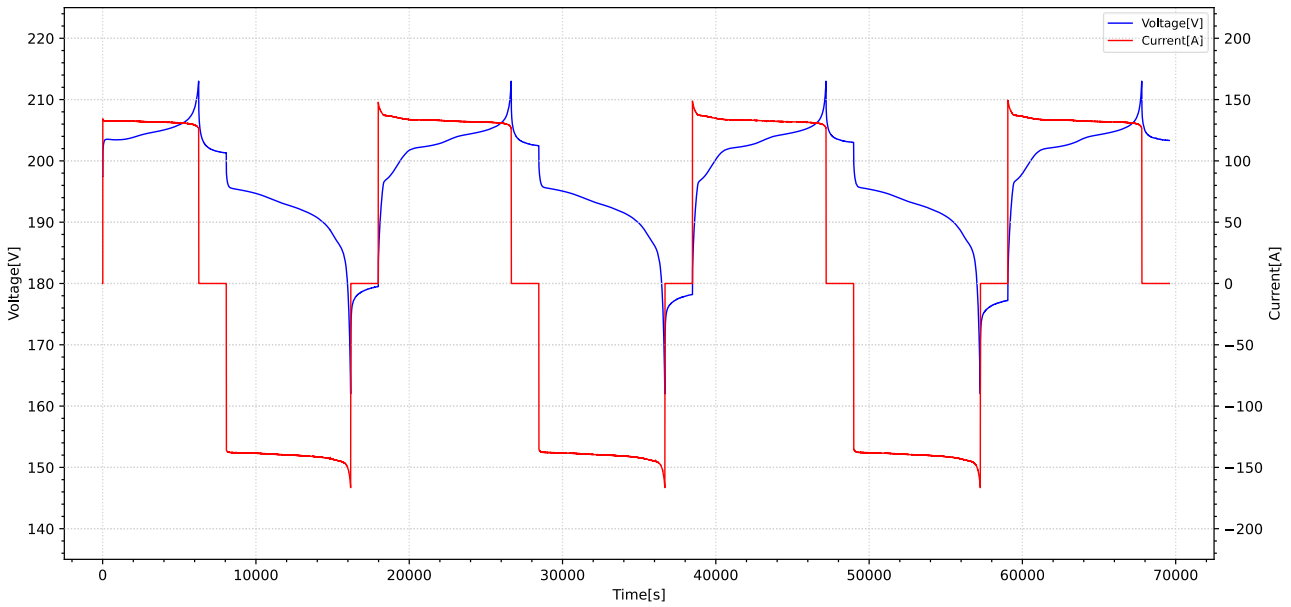

Figure 1 of Attachment 3: charge and discharge cycles chart for initiating module of initiating unit

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Attachment 4: Photo(s) for sample(s) before test and test setup with thermocouple location

Details of:	Figure 1 of Attachment 4 Overview of instrumented walls _before test

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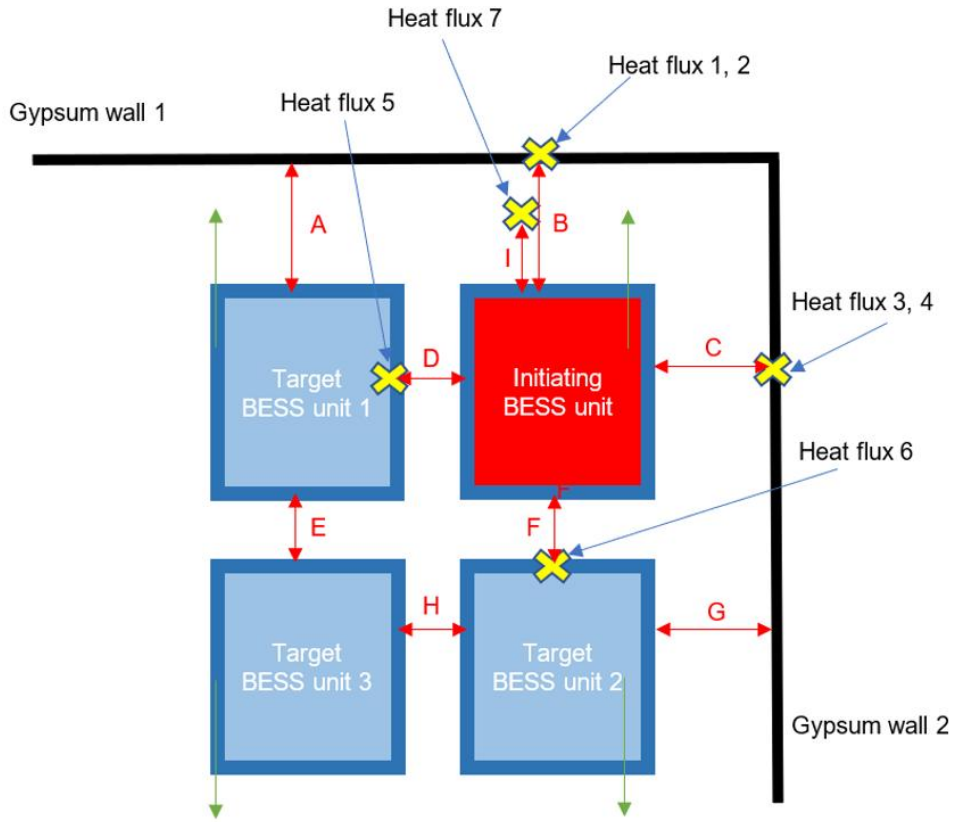
Details of:	Figure 2 of Attachment 4 Location of the heat flux



Item	Height, mm	Distance to Gypsum wall 1, mm	Distance to Gypsum wall 2, mm
Heat flux 1	1133	-	977
Heat flux 2	1018	-	977
Heat flux 3	1147	1300	-
Heat flux 4	1019	1302	-
Heat flux 5	1100	1299	1652
Heat flux 6	1100	2502	977
Heat flux 7	1100	201	976

Remark: A=B=400 mm, C=G=400 mm, E=F=300 mm, D=H=100 mm, I=200 mm

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Details of:	Figure 3 of Attachment 4 Overview of sample & test setup_before test

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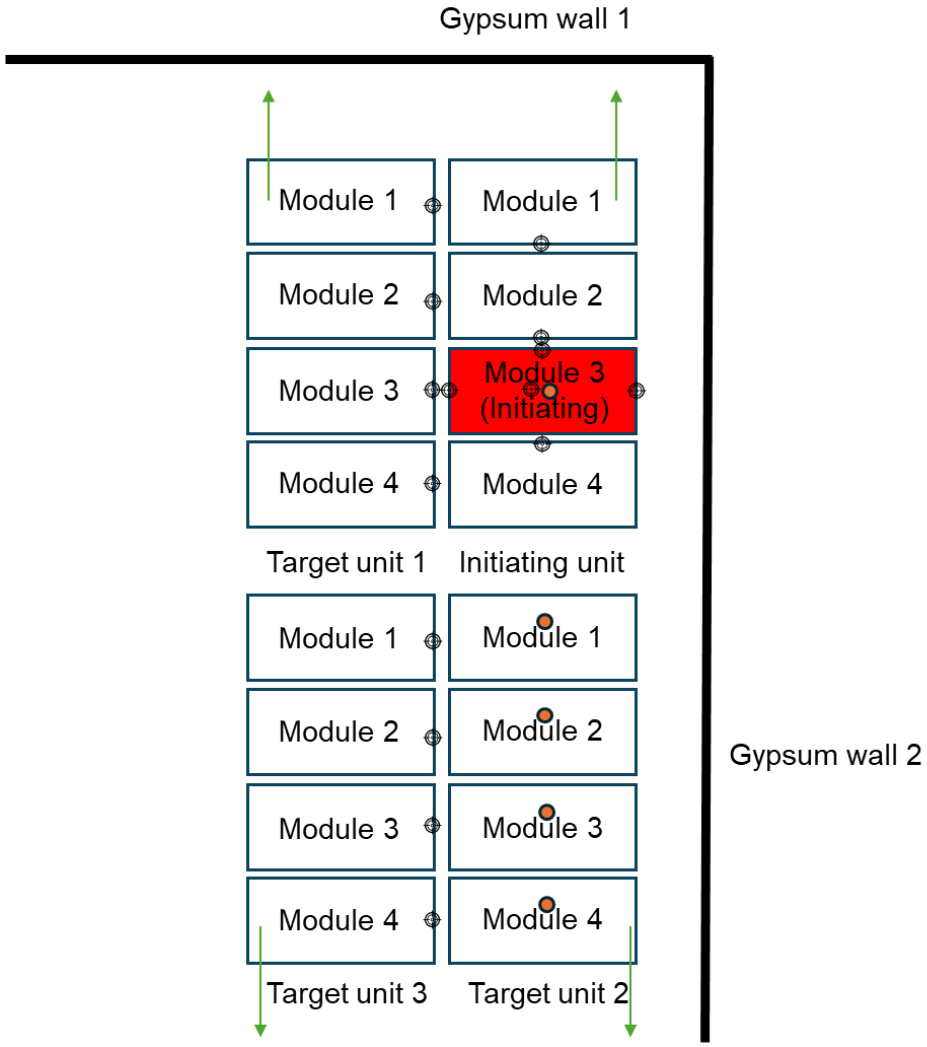
Details of:	Figure 4 of Attachment 4 Overview of sample & test setup_before test



is the temperature measurement location at module surface (front, right, left, top and bottom).

is the temperature measurement location at module surface (back).

is the direction of opening the door.

Module 3 is the initiating module that monitors the temperature of front, back, right, left, top and bottom surfaces.

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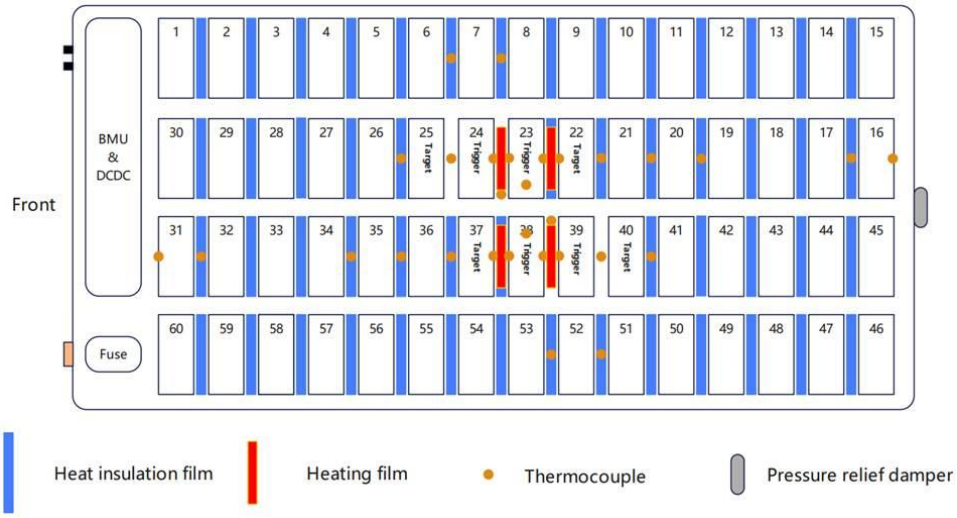
Details of:	Figure 5 of Attachment 4 Thermocouple location for initiating module in the initiating unit



Remark: Cell 23 is the initiating cell. The heat insulation films between Cell 23 and Cell 24, Cell 24 and Cell 25, Cell 38 and Cell 39, Cell 39 and Cell 40 were removed. The heating films attached to Cell 38 were not used during the test.

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Attachment 5: Photo(s) for sample(s) after test

Details of:	Figure 1 of Attachment 5 Overview of sample_after test
	

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Details of:	Figure 2 of Attachment 5 View of initiating unit_after test
	

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Details of:	Figure 3 of Attachment 5 View of initiating module and adjacent modules in initiating unit_after test

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Details of:	Figure 4 of Attachment 5 View of initiating module_after test

Details of:	Figure 5 of Attachment 5 Internal of initiating module_after test

Remark: The internal view of module after test was checked after soaking in salt water.

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Details of:	Figure 6 of Attachment 5 Internal of initiating module_after test
	 Remark: The internal view of module after test was checked after soaking in salt water.

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Attachment 6: Monitored temperature chart

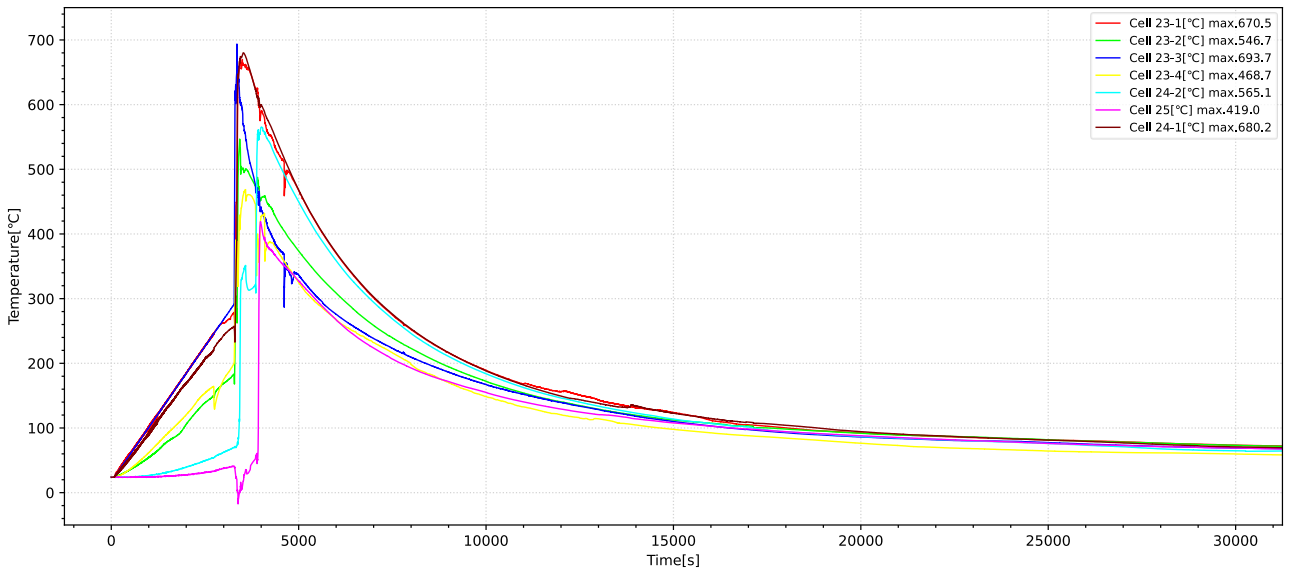

Figure 1 of Attachment 6: Temperatures of initiating cell (Cell 23) and nearby cells (Cell 24 and Cell 25) in initiating module

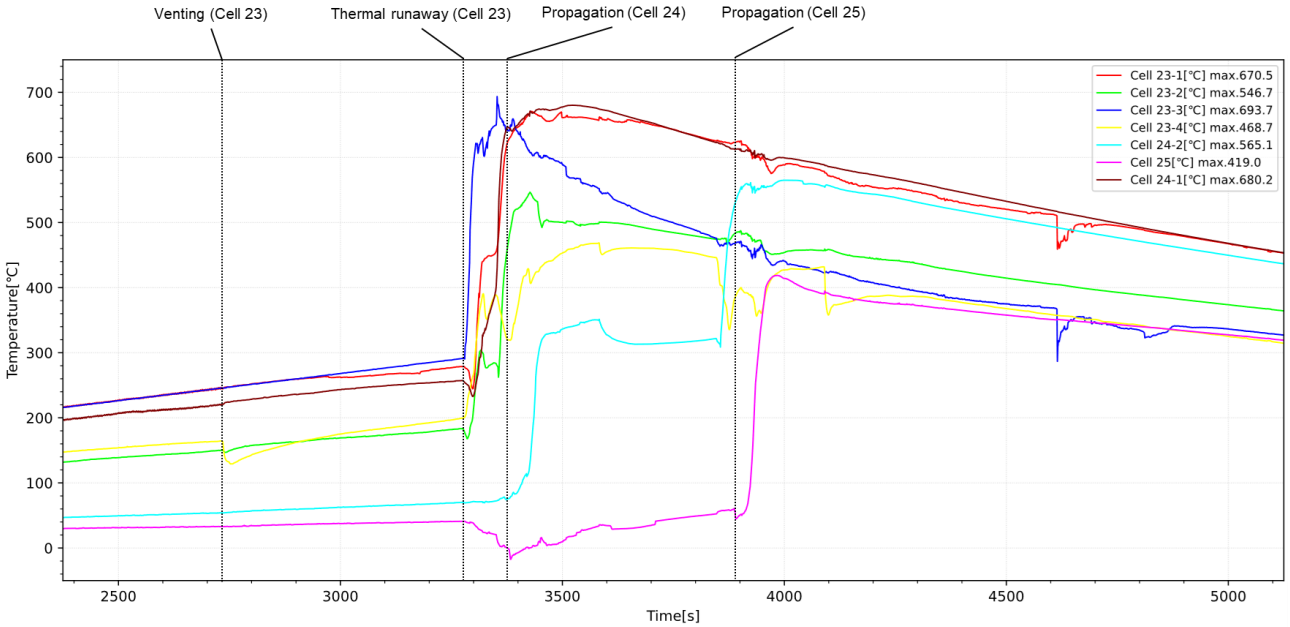

Figure 2 of Attachment 6: Temperatures of initiating cell (Cell 23) and nearby cells (Cell 24 and Cell 25) in initiating module in detail

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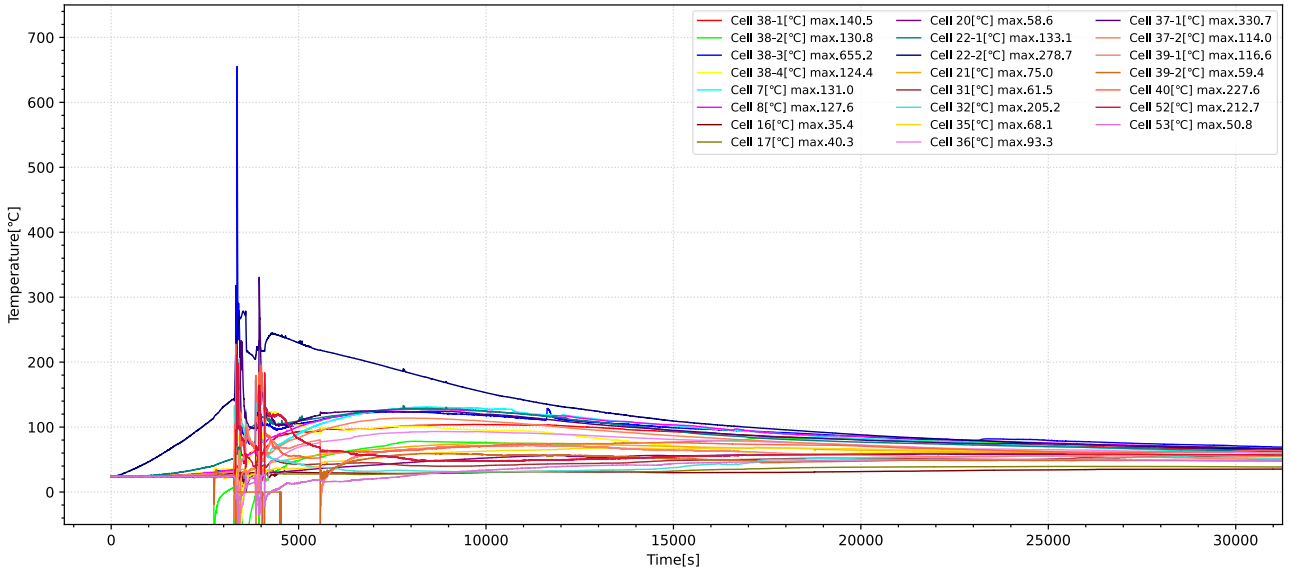

Figure 3 of Attachment 6: Temperatures of other cells in initiating module

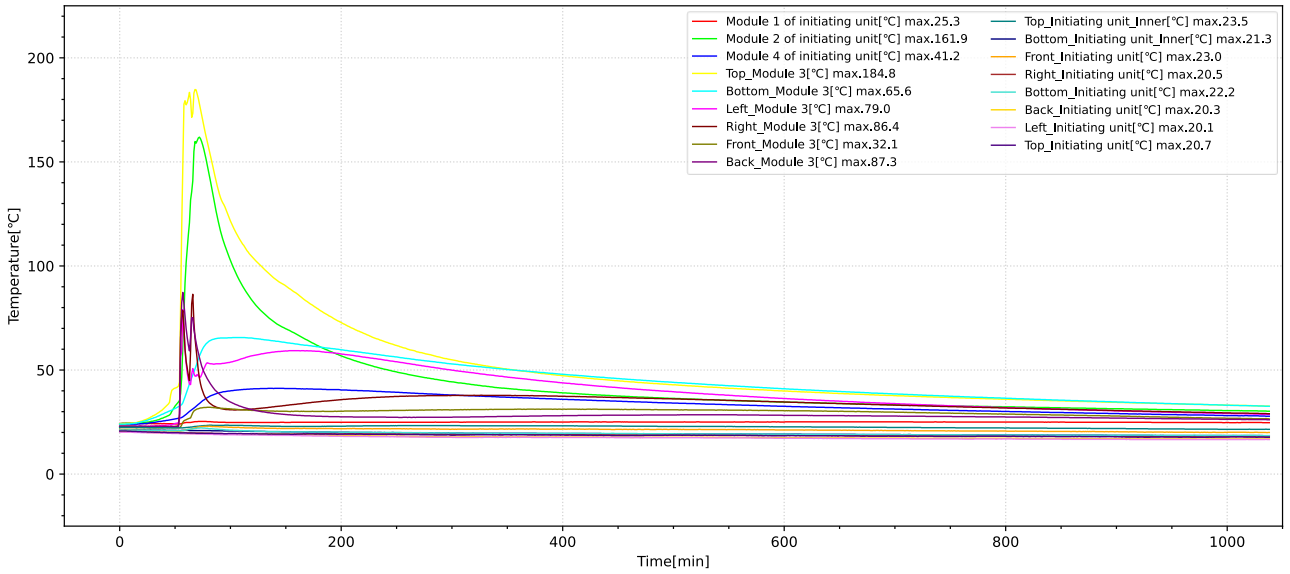

Figure 4 of Attachment 6: Temperatures of module case and unit enclosure of initiating unit

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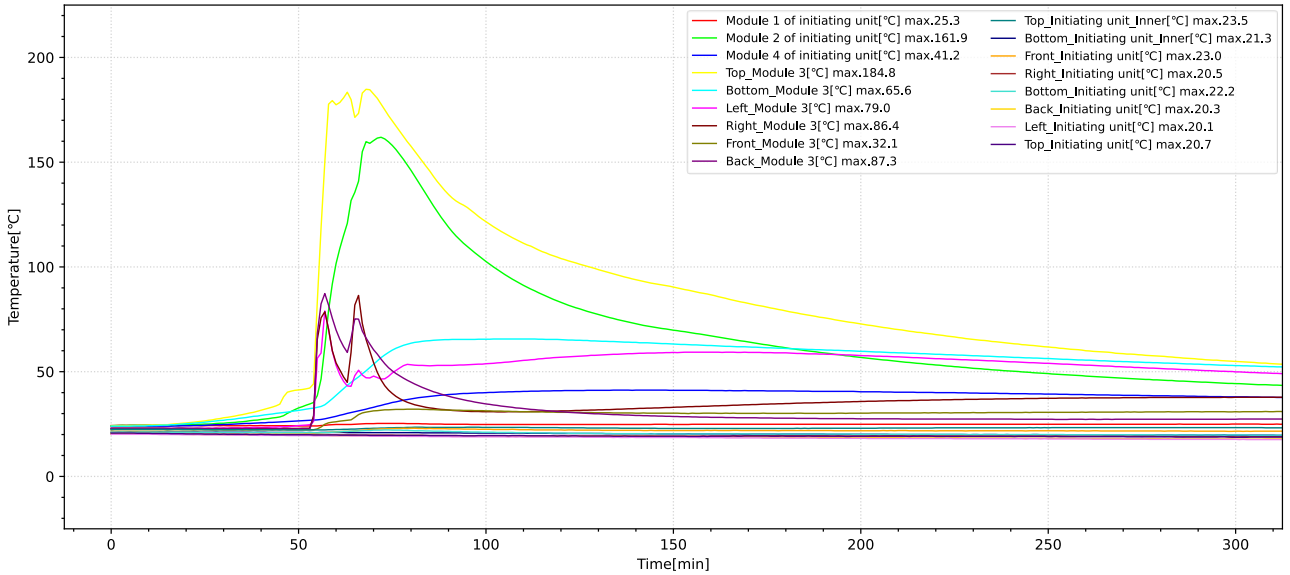

Figure 5 of Attachment 6: Temperatures of module case and unit enclosure of initiating unit in detail

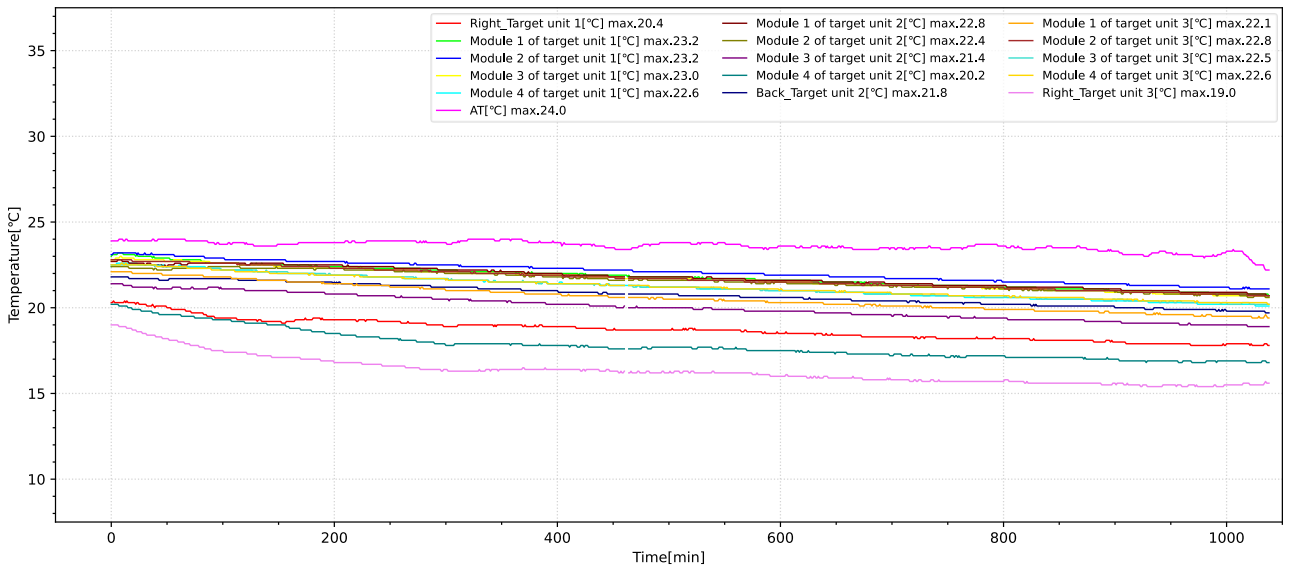

Figure 6 of Attachment 6: Temperatures of all module cases of target units and ambient

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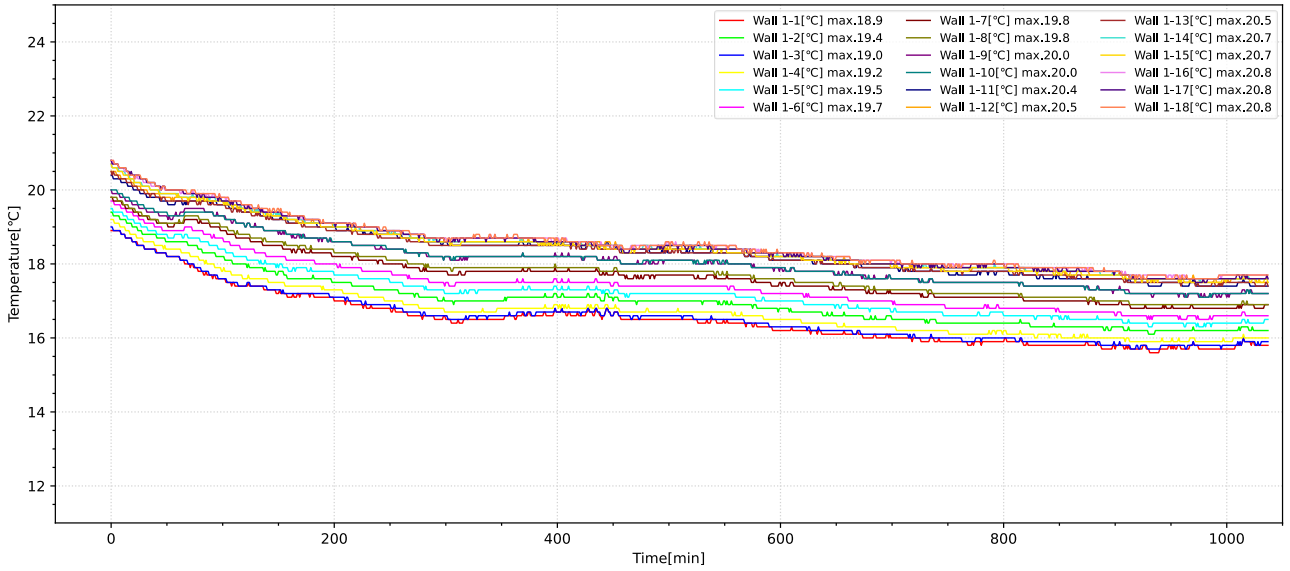

Figure 7 of Attachment 6: Temperatures of wall 1 surface (Wall 1-1 to Wall 1-18 corresponding to bottom to top of wall 1)

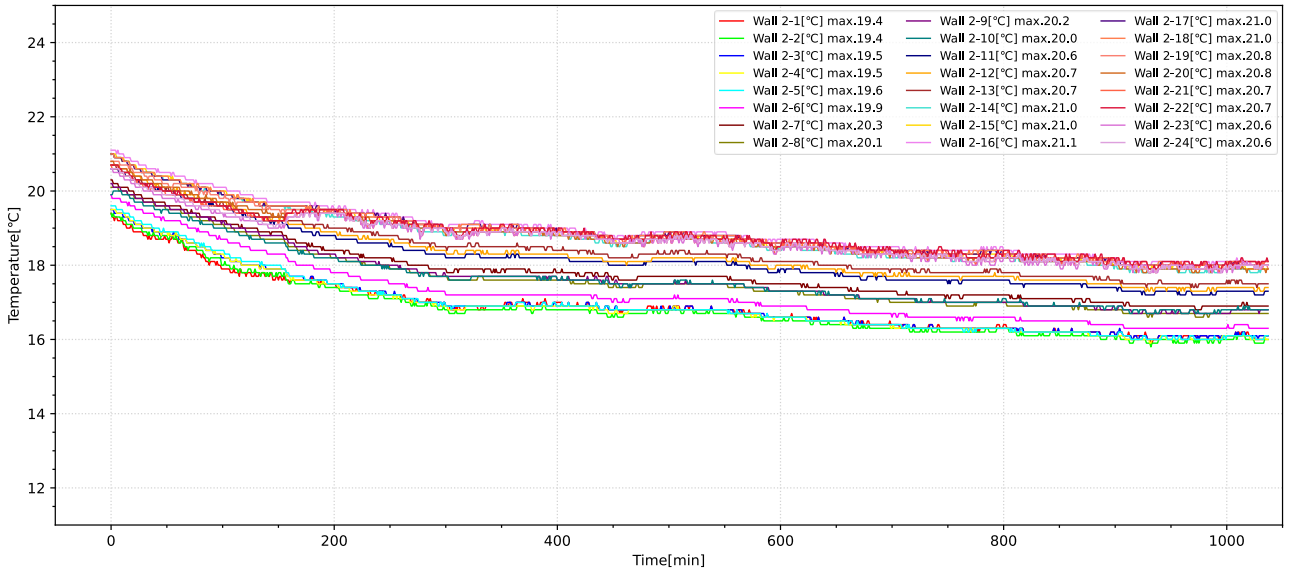

Figure 8 of Attachment 6: Temperatures of wall 2 surface (Wall 2-1 to Wall 2-24 corresponding to bottom to top of wall 2)

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Attachment 7: Flammable gas generation and composition data chart

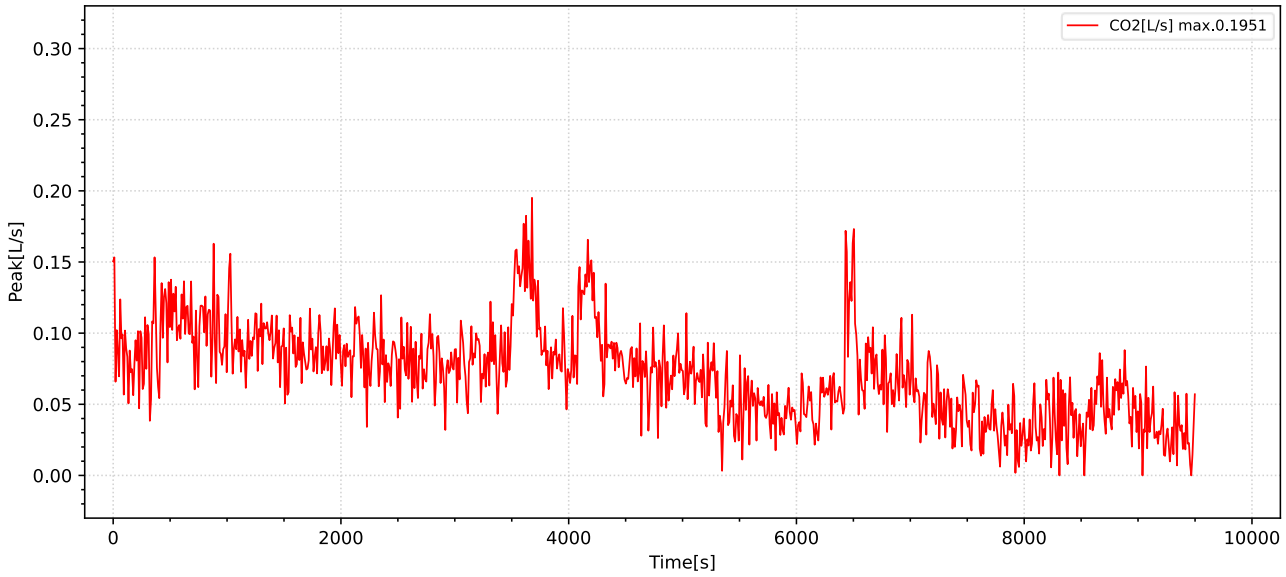

Figure 1 of Attachment 7: Gas generation and composition data chart (Detected by FTIR)

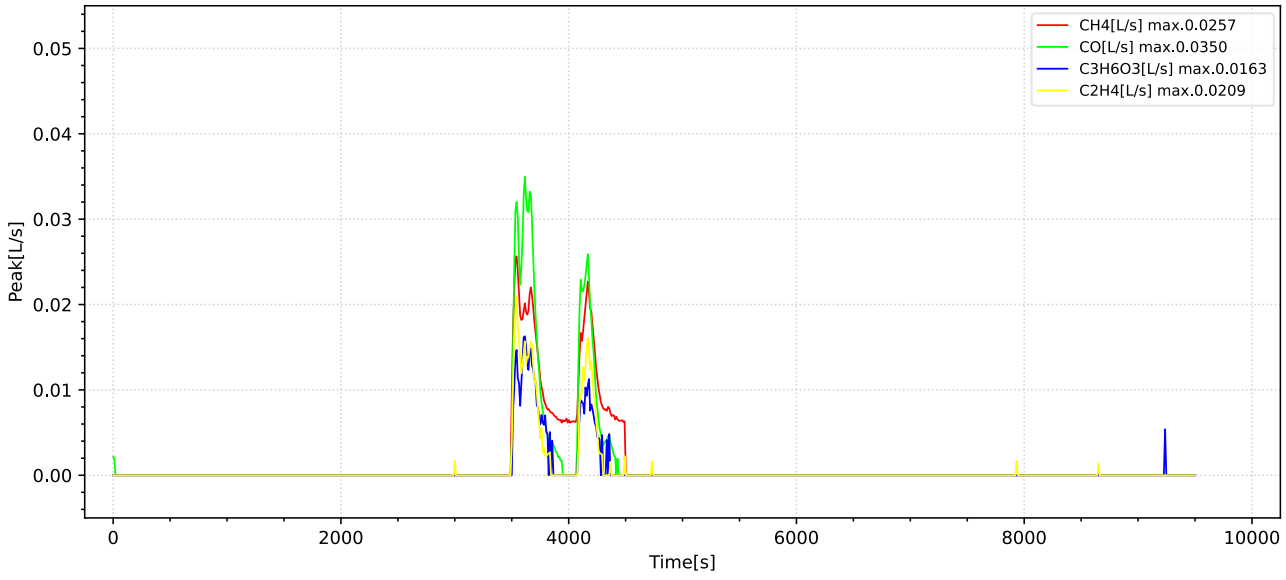

Figure 2 of Attachment 7: Gas generation and composition data chart (Detected by FTIR)

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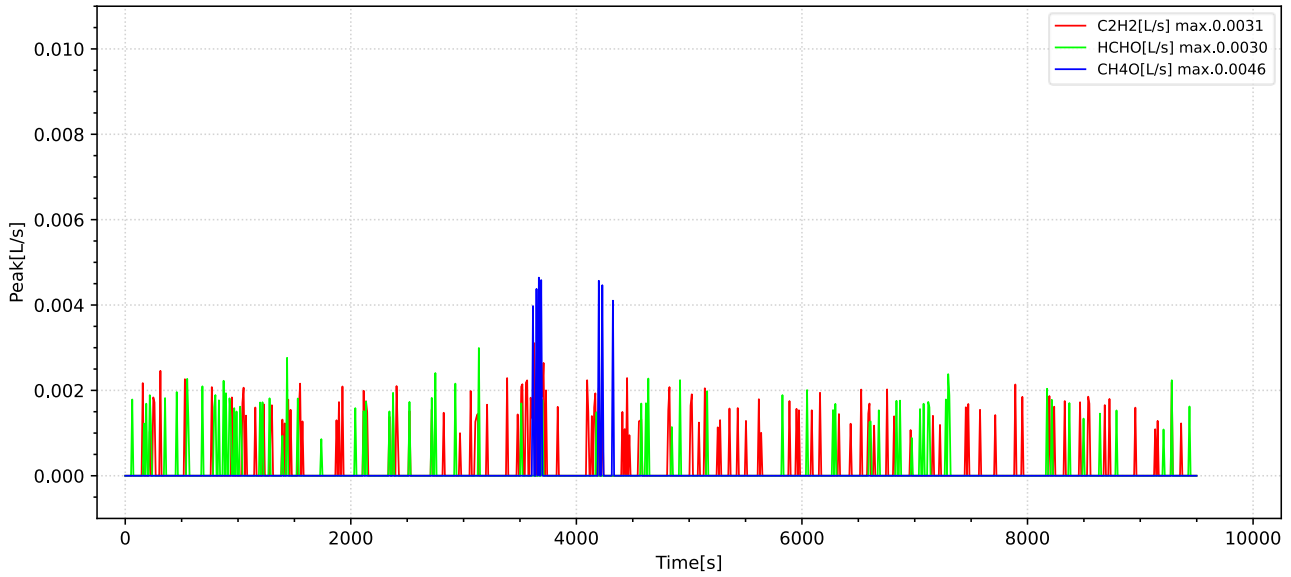

Figure 3 of Attachment 7: Gas generation and composition data chart (Detected by FTIR)

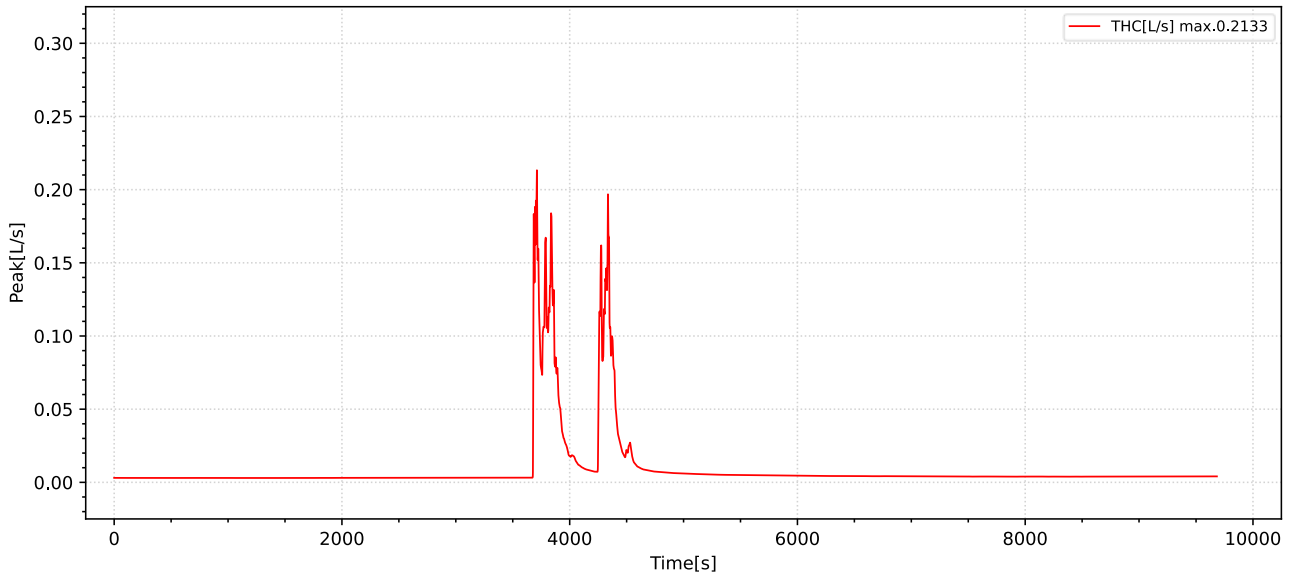

Figure 4 of Attachment 7: THC (Total Hydrocarbon Content) chart (Detected by FID)

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Attachment 8: Heat release rate versus time data chart

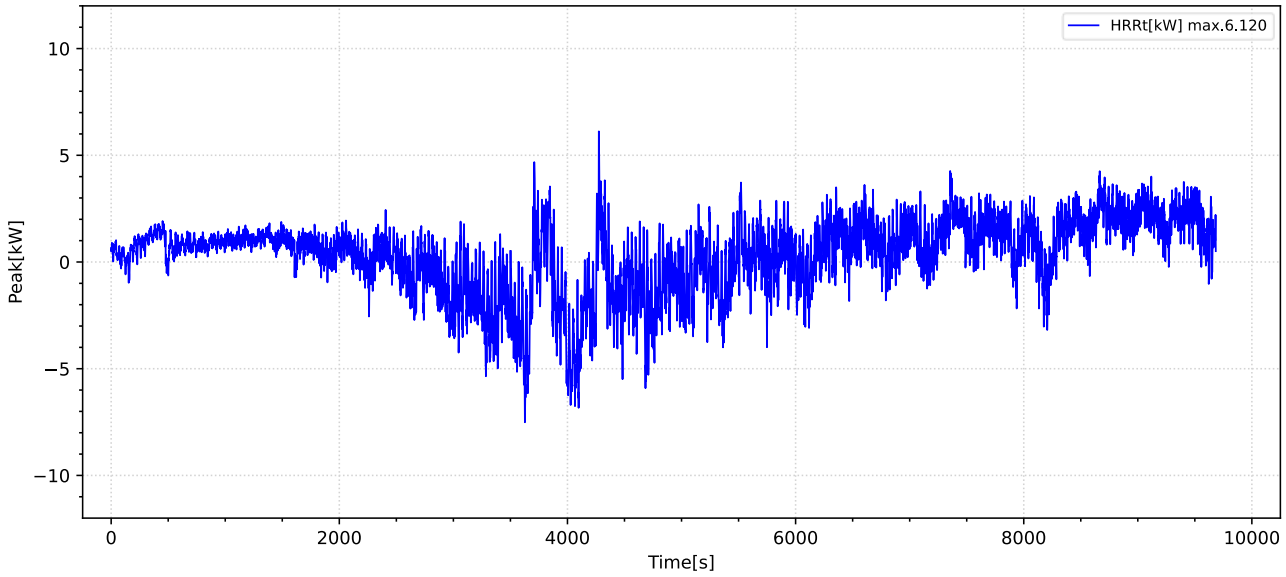

Figure 1 of Attachment 8: Chemical heat release rate (HRRt) versus time data chart

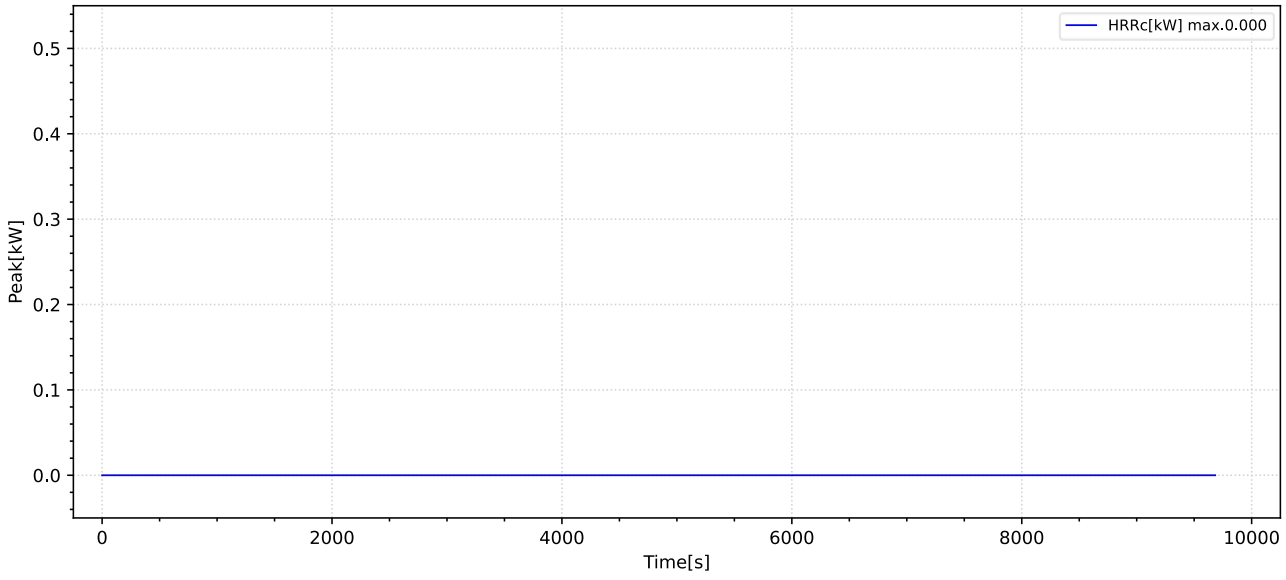

Figure 2 of Attachment 8: Convective heat release rate (HRR_c) versus time data chart

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Attachment 9: Peak smoke release rate and total smoke release data chart

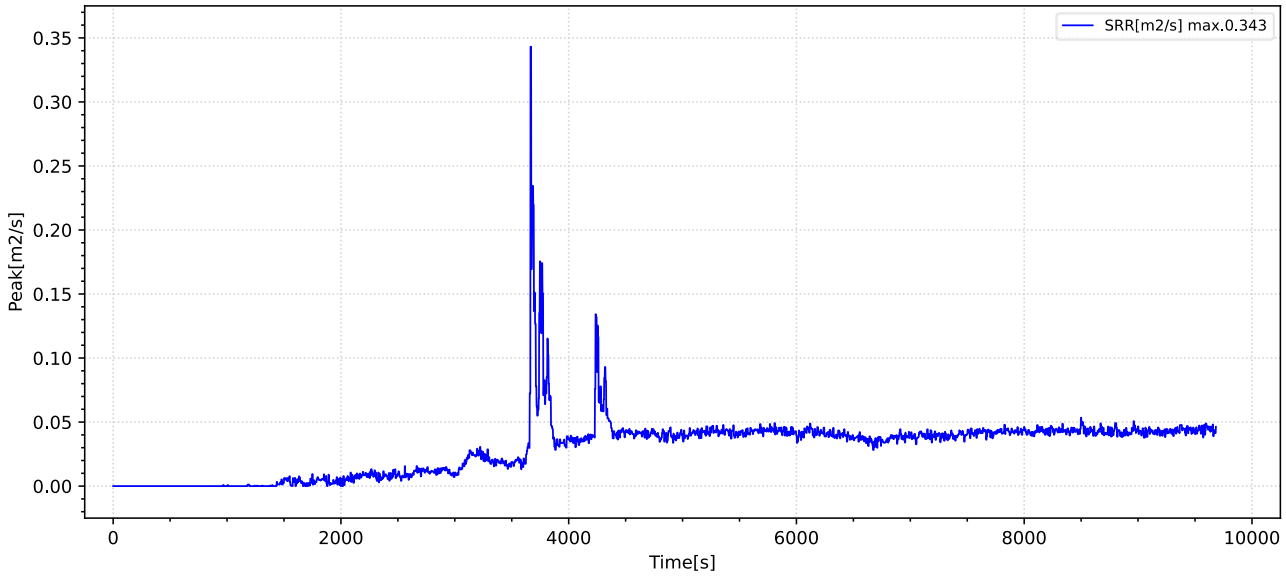

Figure 1 of Attachment 9: Smoke release rate (SRR) data chart

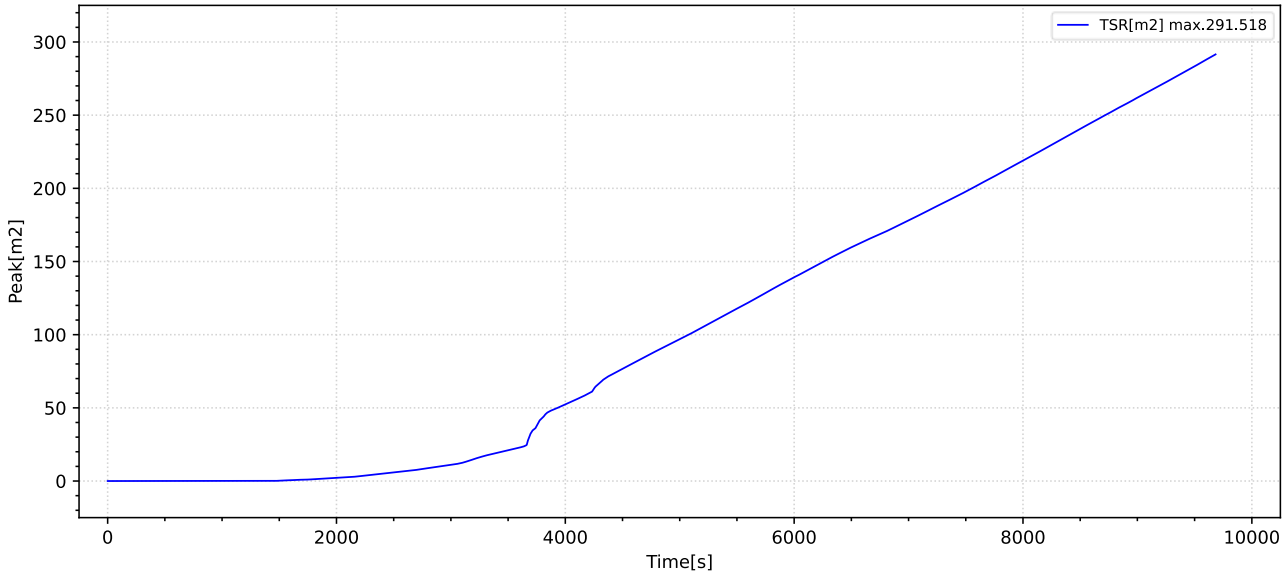

Figure 2 of Attachment 9: Total smoke release (TSR) data chart

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Attachment 10: Summary of Heat release rate & Peak smoke release rate and total smoke release data

Peak heat release rate	6.120 kW
Peak convective heat release rate	0 kW
Total smoke release	291.518 m^2
Peak smoke release rate	0.343 m^2/s

---------- END REPORT ----------

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