Van: [redacted] | Aquasol Solar" <[redacted]@aquasolsolar.nl>
Verzonden: woensdag 5 november 2025 09:37
Aan: [redacted] <[redacted]@ofgv.nl>
Cc: [redacted] <info@termeulenroses.nl>
Onderwerp: RE: noodplan en testrapport UL9450A
Bijlage(n): 241016030GZU-002-UL 9540A unit test report_Security.pdf, Pgs37 Noodplan – Batterij - Termeulen.pdf

Goedemorgen [redacted]

Hierbij verwijs ik wederom naar de bijlage van deze mail. Het getekende document van de veiligheidsregio zal later volgen. Wij hebben slechts nog het mondeling ontvangen, dus zullen dit nogmaals schriftelijk opvragen.
Resultaat 241016030GZU-001 mogen wij helaas niet delen.

Hopelijk u voldoende geïnformeerd te hebben,

R
H

Van: [redacted] <[redacted]@ofgv.nl>
Verzonden: woensdag 5 november 2025 09:18
Aan: [redacted] | Aquasol Solar <[redacted]@aquasolsolar.nl>
CC: [redacted] <info@termeulenroses.nl>
Onderwerp: noodplan en testrapport UL9450A

Beste [redacted]

Wij hebben het geluid beoordeeld en akkoord bevonden.

Voor externe veiligheid zou u mij onderstaande documenten willen aanleveren:

a. De testrapporten UL9450A met nummer 241016030GZU-001 en 241016030GZU-002 van Intertek;
Het document Test Verification of Conformity verwijst naar UL9540 test rapporten, deze zijn niet bijgevoegd.

b. Het noodplan en het actieplan UL9540A maatregelen wat gedeeld is met de veiligheidsregio. En een document waaruit blijkt dat de veiligheidsregio akkoord is.
In de GAP-analyse wordt verwezen naar een noodplan en actieplan UL9540 maatregelen en een afspraak met de veiligheidsregio als alternatief voor M35. Om te kunnen toetsen of dit voldoende is moet de informatie worden aangeleverd en het akkoord van de veiligheidsregio Flevoland.

Alvast bedankt,

Met vriendelijke groet,

[redacted] [redacted]
Medewerker Team Vergunningen

OMGEVINGSDIENST
FLEVOLAND & GOOI EN VECHTSTREEK

Botter 14-15

Postbus 2341
8232 JP Lelystad
E. [redacted]@ofgv.nl
T. [redacted]
W. www.ofgv.nl

Vrijdag in de even weken vrij.

Van: [redacted] | Aquasol Solar <[redacted]@aquasolsolar.nl>
Verzonden: dinsdag 28 oktober 2025 14:14
Aan: [redacted] <[redacted]@ofgv.nl>
Onderwerp: RE: Gap Analyse typical 3 - Termeulen Roses

Dag [redacted]

Ik heb hem op deze manier opgesteld conform de template die ik heb opgevraagd bij een verzekeringsinstantie.

Dit in combinatie met de documenten die ik aan [redacted] heb aangeboden zoals de UL9540A testresultaten. Informatieblad en samenstelling batterijsysteem + aanvullende documentatie over veiligheidsvoorzieningen.

Deze heeft hij al naar u gemaild, dus ik hoop op hele korte termijn een voorlopige go te krijgen om de werkzaamheden aan te vangen.

Groet,
R
H

Van: [redacted] <[redacted]@ofgv.nl>
Verzonden: dinsdag 28 oktober 2025 14:09
Aan: [redacted] | Aquasol Solar <[redacted]@aquasolsolar.nl>
Onderwerp: RE: Gap Analyse typical 3 - Termeulen Roses

Goedemiddag [redacted]

- ***Een GAP-analyse*** laat zien in hoeverre uw installatie (EOS) voldoet aan de PGS 37-1, versie 1.0 van december 2023. Daarbij worden alle relevante maatregelen uit hoofdstuk 7 van de PGS-richtlijn getoetst op toepasbaarheid voor uw installatie. Indien (delen van) de installatie niet voldoen aan de PGS 37-1, dient u te beschrijven welke gelijkwaardige maatregelen worden getroffen.
  https://publicatiereeksgevaarlijkestoffen.nl/publicaties/online/pgs-37-1/2023/1-0-december-2023#7

Onderstaand treft u twee voorbeelden van een GAP-analyse. U kunt deze analyses opstellen in Excel. In het laatste deel van de analyse is ruimte voorzien om uw opmerkingen te noteren.

Ter ondersteuning heb ik in de bijlage een soortgelijk rapport voor PGS 29 toegevoegd.

1.

Maatregel	Omschrijving	EOS voldoet aan maatregel			Toelichting
		ja	nee	n.v.t.	
7.2 Basisveiligheid					
MW1	Zorgplicht basis veiligheid				
7.3 Ontwerp en constructie					
7.3.1 constructie en installatie					
M2	Minimale veiligheidseisen EOS en energiedrager				
M3	Traceerbaarheid				

M4
.

2.


Beheersmaatregelen PGS37-1 - typical 1

Kolom1	Maatregelomschrijving	Toelichting	Verantwoordelijke partij	Opmerking
2	Minimale veiligheidseisen EOS en energiedrager	[redacted]	Fabrikant	[redacted]
3	Traceerbaarheid	[redacted]	Fabrikant en Fruitbedrijf van Rijn op locatie	[redacted]

Met vriendelijke groet,

[redacted]
Medewerker Team Vergunningen

OMGEVINGSDIENST
FLEVOLAND & GOOI EN VECHTSTREEK

Botter 14-15
Postbus 2341
8232 JP Lelystad
E. [redacted]@ofgv.nl
T. [redacted]
W. www.ofgv.nl

Vrijdag in de even weken vrij.

Van: [redacted] | Aquasol Solar <[redacted]@aquasolsolar.nl>
Verzonden: dinsdag 28 oktober 2025 08:58
Aan: [redacted] <[redacted]@ofgv.nl>
Onderwerp: Gap Analyse typical 3 - Termeulen Roses

Goedemorgen [redacted],

Zojuist hebben wij telefonisch contact met elkaar gehad over de GAP analyse voor [redacted], firma Termeulen Roses.
Graag ontvang ik een voorbeeld voor het type 3 EOS om deze naar waarheid en volledigheid te kunnen invullen om voor [redacted] aanstaande maandag de werkzaamheden te kunnen starten.

Alvast dank voor de reactie.
R
H

Disclaimer: De inhoud van deze e-mail inclusief eventuele bijlage(n) is uitsluitend bedoeld voor de geadresseerde. Er kunnen geen rechten aan worden ontleend, tenzij schriftelijk overeengekomen. De proclaimer en algemene voorwaarden van de OFGV vindt u op https://www.ofgv.nl/algemeen/proclaimer

Test Report issued under the responsibility of:

intertek
Total Quality. Assured.

TEST REPORT
ANSI/CAN/UL 9540A:2019
Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

Report Reference No..... :	241016030GZU-002
Tested by (name + signature) ..... :	[redacted] Engineer ..... [redacted]
Approved by (name + signature) ..... :	[redacted] Reviewer ..... [redacted]
Total number of pages..... :	65
Date of issue..... :	11 April 2025
Testing Laboratory..... :	Intertek Testing Services Shenzhen Ltd. Zengcheng Branch
Address..... :	C2-1, Heping Xu, Yongning Street, Zengcheng District, Guangzhou, China
Testing location/ procedure ..... :	Lab test
Testing location/ address..... :	Intertek Testing Services Shenzhen Ltd. Zengcheng Branch C2-1, Heping Xu, Yongning Street, Zengcheng District, Guangzhou, China
Applicant's name ..... :	Sigenergy Technology Co., Ltd.
Address..... :	No. 175 Weizhan Road, Lingang New Area, China(Shanghai) Pilot Free Trade Zone, Shanghai, P.R.China
Test specification:	
Standard ..... :	ANSI/CAN/UL 9540A:2019 (Fourth Edition) + UL CRD's
Test procedure..... :	Unit level test (clause 9.1-9.8)
Non-standard test method……..... :	N/A
Test Report Form No. ..... :	ANSI/CAN/UL 9540A_Unit
Test Report Form(s) Originator ..... :	Intertek
Master TRF ..... :	2022-01

Test item description ..... :	SigenStack Energy Storage System
Trade Mark ..... :	Sigenergy
Manufacturer..... :	Sigenergy Technology Co., Ltd. No. 175 Weizhan Road, Lingang New Area, China(Shanghai) Pilot Free Trade Zone, Shanghai, P.R.China
Model/Type reference..... :	Refer to page 13 for details
Ratings..... :	Refer to page 14-18 for details

List of attachments:

Attachment 1 – Photos

Attachment 2 – Sample preparation

Attachment 3 – Arrangement of the unit

Attachment 4 – Thermal runaway preparation

Attachment 5 – Observations and records

Attachment 6 – Temperature measurements

Attachment 7 – Heat flux measurements

Attachment 8 – Chemical heat release rate measurement

Attachment 9 – Convective heat release rate measurement

Attachment 10 – Gas generation measurement

Attachment 11 – Smoke release rate measurement

Attachment 12 – Equipment list

Test video 20250315-1.mp4 to 20250315-9.mp4 were provided in addition to this test report.

Summary of testing:

Thermal Runaway Propagation.....:	3 cells vented and thermal runaway due to thermal runaway propagation in the initiating module 2. 7 cells in the initiating module 2 vented but no thermal runaway. No thermal runaway propagation from initiating module to other modules in initiating unit.
Maximum Target BESS Temperature (°C) .....:	27.3°C
Maximum Wall Surface Temperature (°C) .....:	39.5°C
Maximum Heat Flux on target wall surfaces (kW/m^2) ..:	N/A
Maximum Heat Flux on target BESS units (kW/m^2) .....:	N/A
Peak Chemical Heat Release Rate (kW) .....:	9.88kW
Peak Convective Heat Release Rate (kW) .....:	0kW
Peak Smoke Heat Release Rate (m^2/s) .....:	0.1987m^2/s
Total Smoke Release (m^2) .....:	109.4m^2
Maximum Heat Flux on Egress Path (kW/m^2) .....:	0.029kW/m^2
External Flaming from BESS .....:	Not observed
Flying debris or explosive discharge of gases .....:	Not observed
Sparks, electrical arcs, or other electrical events .....:	Not observed
Re-ignitions .....:	Not observed

Conclusion:

The performance criteria of the unit level test as indicated in 9.8 of UL 9540A 4th edition has been met.

Installation level testing in Section 10 is not required because the performance conditions outlined in Table 9.1 are met during the unit level test.

Possible test case verdicts:	
- test case does not apply to the test object.....:	N/A
- test object was not evaluated for the requirement.....:	N/A
- test object does meet the requirement.....:	Pass (P)
- test object does not meet the requirement .....:	Fail (F)
Testing:	
Date of receipt of test items .....:	11 March 2025
Date(s) of performance of tests.....:	13 March 2025 to 17 March 2025

General remarks:

"(see Attachment #)" refers to additional information appended to the report.

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

The tests 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.

List of test equipment must be kept on file and available for review.

Additional test data and/or information provided in the attachments to this report.

Throughout this report a ☐ comma / ☒ **point** is used as the decima separator.

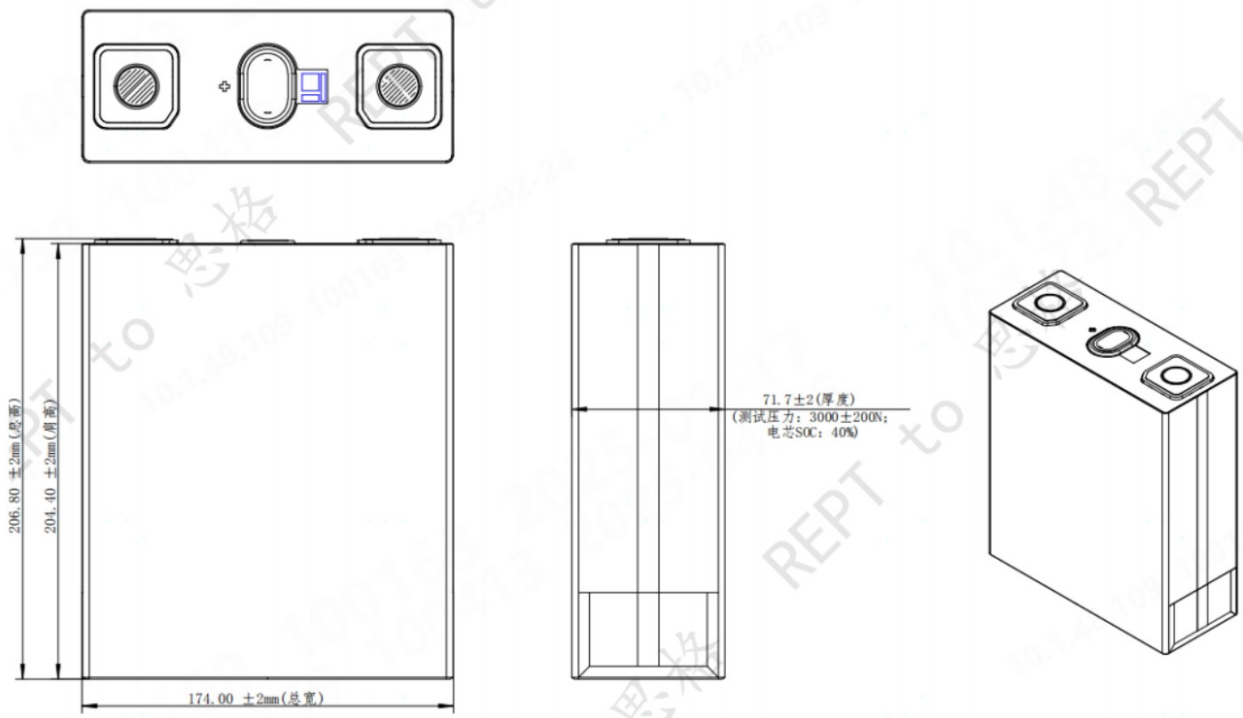
Determination of the test results includes consideration of measurement uncertainty from the test equipment and methods.

General product information:

This test unit is a non-residential indoor floor mounted and outdoor ground mounted energy storage system. It also can cover non-residential open garage and non-residential rooftop use energy storage system.

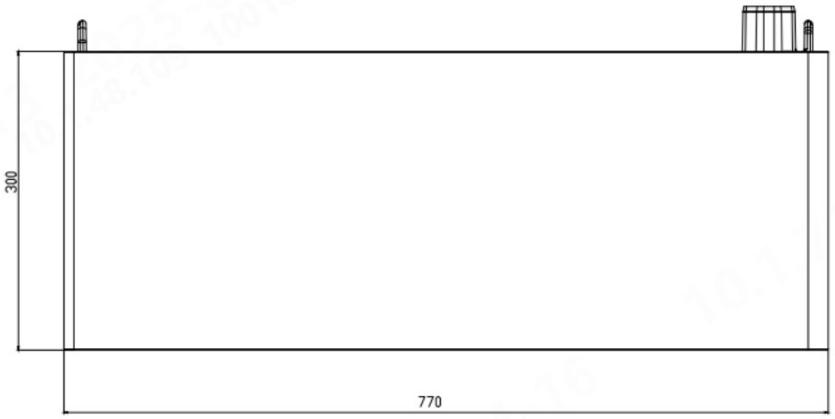
Product information:	
Cell information	
Manufacturer.....:	REPT BATTERO Energy Co., Ltd.
Model name .....:	CB75
Chemistry.....:	$LiFePO_4$
Physical configuration.....:	Prismatic
Dimension (W*H*T) .....:	174(±2) mm x 204.4(±2) mm x 71.7(±2) mm
Weight.....:	5.78±0.3 kg
Nominal voltage .....:	3.2V
Rated capacity .....:	314Ah
If the cell compliance with UL 1973 .....:	Compliance / Report No. CN23RW5E 001 Certification No. CU 72303136 01-02
Standard charge method	
Charge current.....:	157 A
End of charge voltage.....:	3.65 V
Cut off current .....:	15.7 A
Standard discharge method	
Discharge current .....:	157 A
End of discharge voltage .....:	2.5 V
Test result from cell level 9540A test report	
Cell level test report .....:	Issued by TUV Rheinland (Shanghai) Co., Ltd. Report No.: CN234568 001
Average cell venting temperature ..... :	127.9 °C
Average cell thermal runaway onset temperature ....:	179.8 °C
Gas composition .....:	See cell level UL9540A test report
LFL at ambient temperature .....:	7.7% at 24°C±2°C and 101±3kPa
LFL cell venting temperature .....:	7.1% at 127.9°C±2°C and 101±3kPa
Burning velocity .....:	0.688 m/s
P_{max} .....:	0.798 Mpa

Diagram of cell with overall dimension

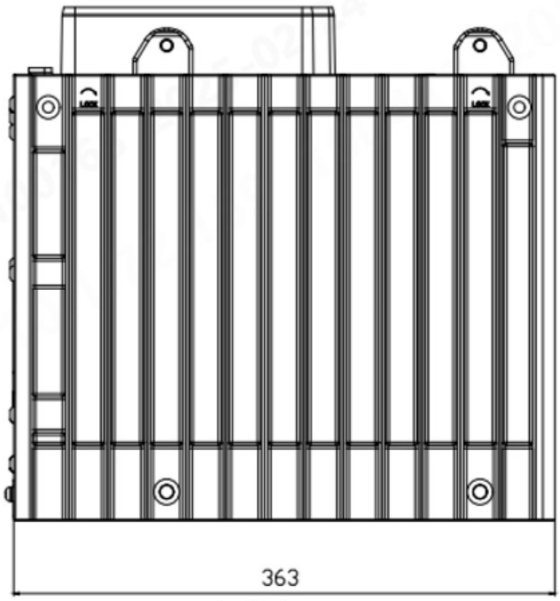


Module information	
Manufacturer.....:	Sigenergy Technology Co., Ltd.
Model name.....:	SigenStack BAT 12.0
Physical configuration	
Enclosure material.....:	Metal
Dimension (L*W*H) .....:	770 mm x 363 mm x 300 mm
Weight.....:	105.5 kg
Cells in series/parallel: .....:	1P12S
Total number of cells: .....:	12 cells
Cooling method .....:	Electric fan
Separation between cells .....:	4.2 mm by silicone foam
Electrical rating	
Rated energy .....:	12060 Wh
Nominal voltage.....:	38.4V
Standard charge method	
Charge power.....:	6.0288kW
End of charge voltage.....:	42.6V
Standard discharge method	
Discharge power .....:	6.0288kW
End of discharge voltage.....:	34.8V
If the module compliance with UL 1973 .....:	NA
Test result from module level 9540A test report	
Module level test report .....:	241016030GZU-001
Peak chemical heat release rate HRR (kW) .....:	19.11kW
Peak smoke release rate SRR (m^2/s) .....:	9.291 m^2/s
Total smoke release TSR (m^2) .....:	2286.05m^2
Total Hydrocarbons (equivalent to CH_4, measured by FID).....:	617.16 L
Module weight loss (kg).....:	8.5kg

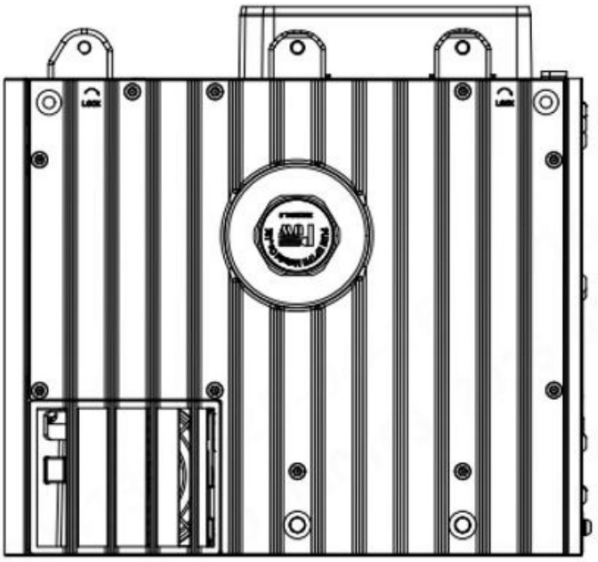
Diagram of module with overall dimension
Unit: mm



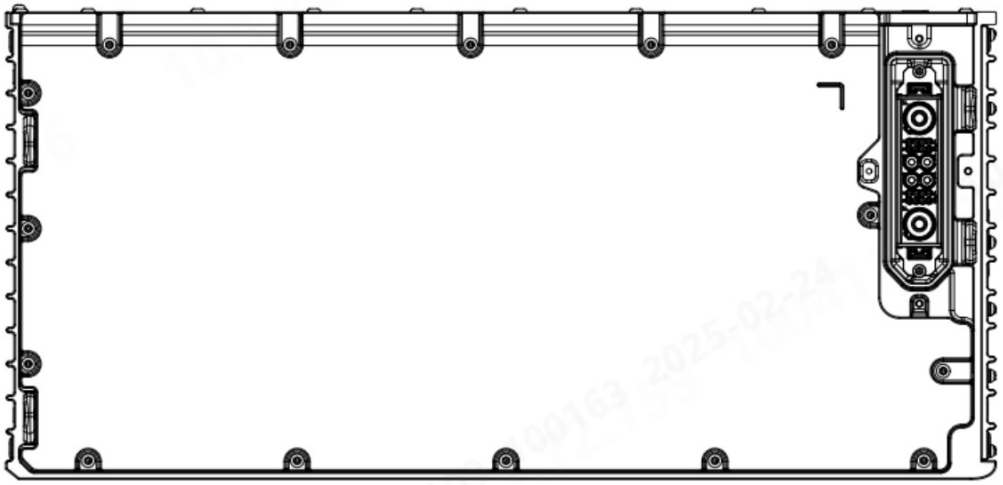
Front view



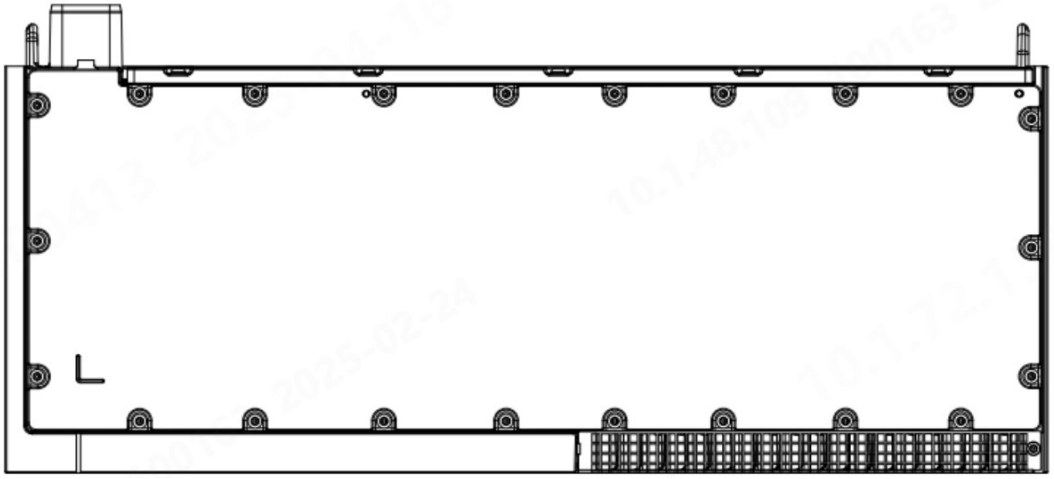
Left view



Right view

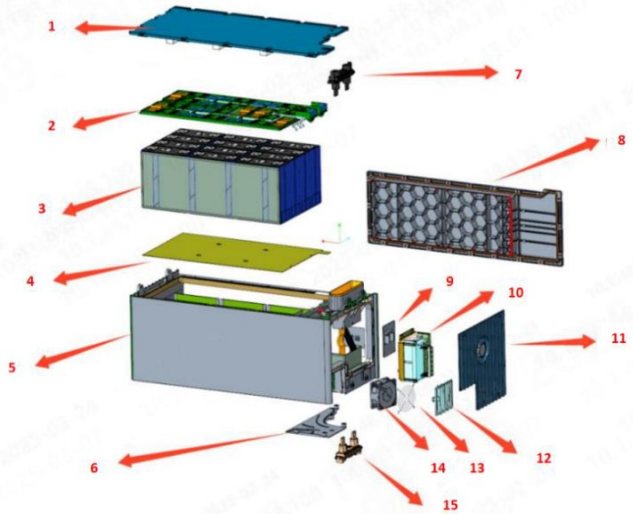


Top view



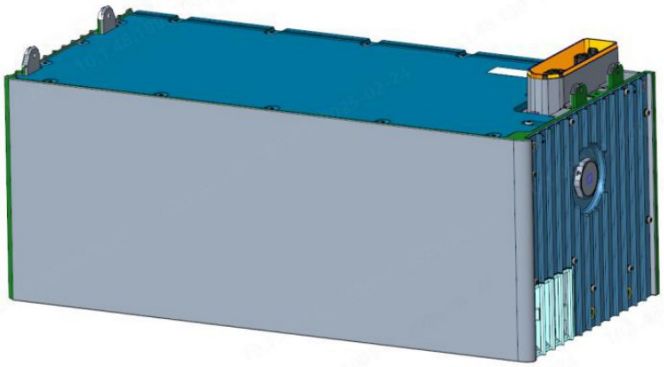
Bottom view

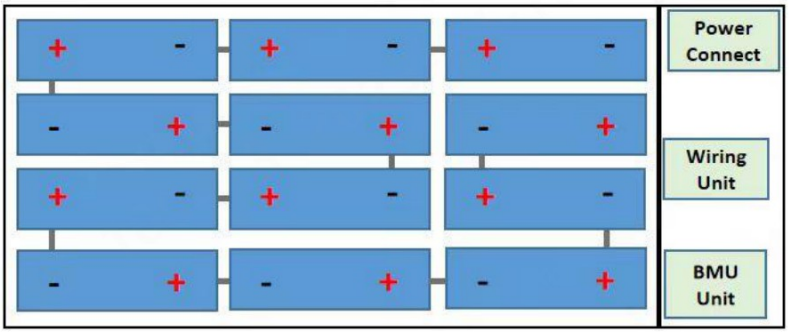
Contents (main components) of the module

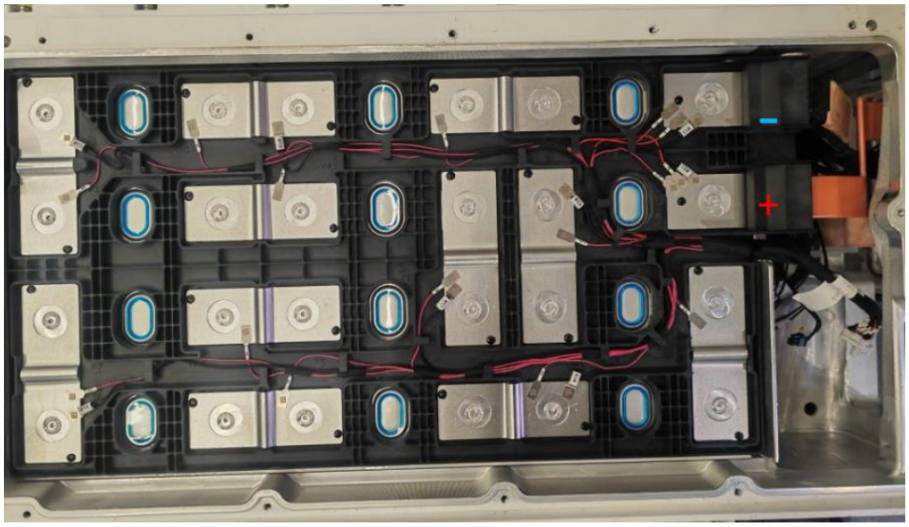


PACK					
1	Upper Cover	8	Rear Cover	15	Lower Floating Plug
2	Cell Connection System	9	Transition Board		
3	Battery Cell	10	Battery Management System		
4	Heating Film	11	Right Cover		
5	Housing	12	Outlet Guard		
6	Air Duct Guard	13	Fan Guard		
7	Upper Floating Plug	14	Fan		

Layout of the module contents







Module structure diagram and cell series and/or parallel configuration (with cell numbered)

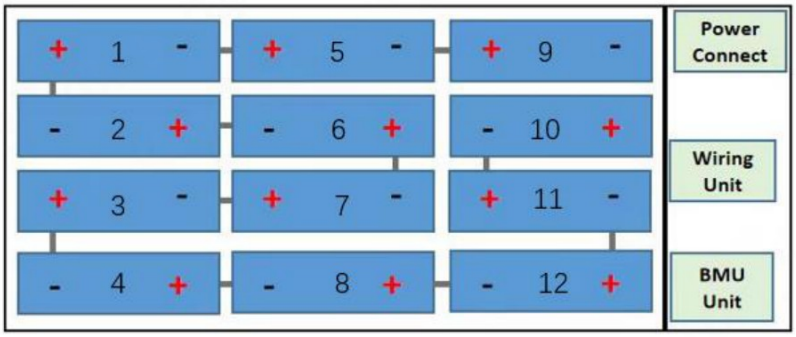
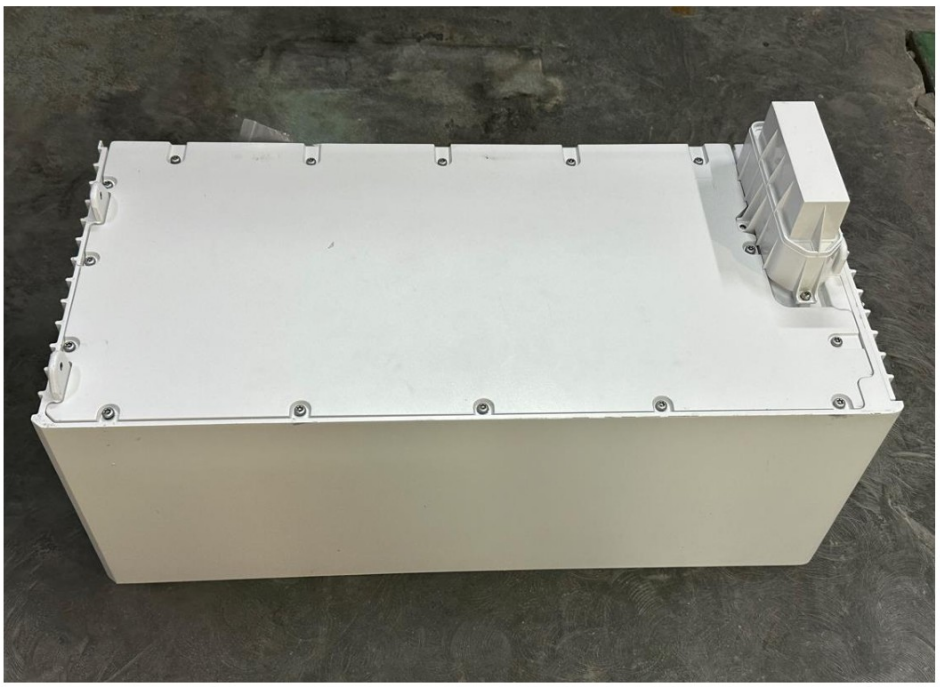
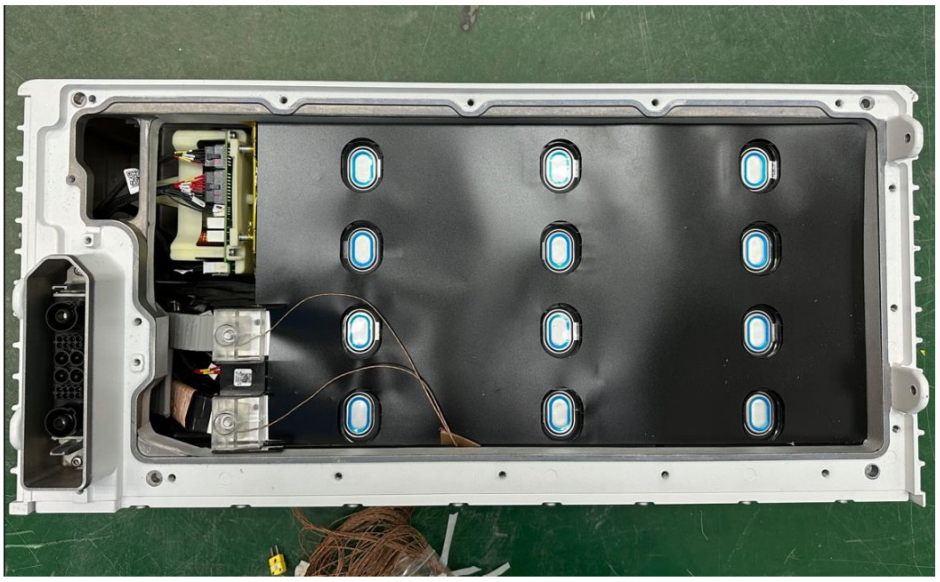


Photo of the module





Unit information		
Manufacturer:	Sigenergy Technology Co., Ltd.	
Model:	SigenStack M2-0.5C-20/241.15 kWh, SigenStack M2-0.5C-21/253.21 kWh,SigenStack M2-0.5C-22/265.27 kWh, SigenStack M2-0.5C-23/277.32 kWh,SigenStack M2-0.5C-24/289.38 kWh, SigenStack M2-0.5C-25/301.44 kWh,SigenStack M2-0.5C-BST-4/48.23 kWh, SigenStack M2-0.5C-BST-5/60.29 kWh,SigenStack M2-0.5C-BST-6/72.35 kWh, SigenStack M2-0.5C-BST-7/84.4 kWh, SigenStack M2-0.5C-BST-8/96.46 kWh, SigenStack M2-0.5C-BST-9/108.52 kWh, SigenStack M2-0.5C-BST-10/120.58 kWh, SigenStack M2-0.5C-BST-11/132.63 kWh, SigenStack M2-0.5C-BST-12/144.69 kWh, SigenStack M2-0.5C-BST-13/156.75 kWh, SigenStack M2-0.5C-BST-14/168.81 kWh, SigenStack M2-0.5C-BST-15/180.86 kWh, SigenStack M2-0.5C-BST-16/192.92 kWh, SigenStack M2-0.5C-BST-17/204.98 kWh, SigenStack M2-0.5C-BST-18/217.04 kWh, SigenStack M2-0.5C-BST-19/229.09 kWh, SigenStack M2-0.5C-BST-20/241.15 kWh, SigenStack M2-0.5C-BST-21/253.21 kWh, SigenStack M2-0.5C-BST-22/265.27 kWh, SigenStack M2-0.5C-BST-23/277.32 kWh, SigenStack M2-0.5C-BST-24/289.38 kWh, SigenStack M2-0.5C-BST-25/301.44 kWh, SigenStack M2-1C-BST-4/48.23 kWh, SigenStack M2-1C-BST-5/60.29 kWh, SigenStack M2-1C-BST-6/72.35 kWh, SigenStack M2-1C-BST-7/84.4 kWh, SigenStack M2-1C-BST-8/96.46 kWh, SigenStack M2-1C-BST-9/108.52 kWh, SigenStack M2-1C-BST-10/120.58 kWh, SigenStack M2-1C-BST-11/132.63 kWh, SigenStack M2-1C-BST-12/144.69 kWh, SigenStack M2-1C-BST-13/156.75 kWh, SigenStack M2-1C-BST-14/168.81 kWh, SigenStack M2-1C-BST-15/180.86 kWh, SigenStack M2-1C-BST-16/192.92 kWh, SigenStack M2-1C-BST-17/204.98 kWh, SigenStack M2-1C-BST-18/217.04 kWh, SigenStack M2-1C-BST-19/229.09 kWh, SigenStack M2-1C-BST-20/241.15 kWh, SigenStack M2-1C-BST-21/253.21 kWh, SigenStack M2-0.5C-BST-22/265.27 kWh, SigenStack M2-1C-BST-23/277.32 kWh, SigenStack M2-1C-BST-24/289.38 kWh, SigenStack M2-1C-BST-25/301.44 kWh	
Test model:	SigenStack M2-0.5C-BST-25/301.44 kWh	
Type of system:	☐ Battery System (BS)	☒ Battery ESS
Intended use location:	☐ Residential ☒ Non-residential rooftop ☒ Non-residential open garage use	☒ Non-residential
Type of installation:	☒ Indoor floor mounted ☐ Indoor wall mounted	☒ Outdoor ground mounted ☐ Outdoor wall mounted
Enclosure material:	☒ Metal ☐ Open rack	☒ Non-metal
Spacing between modules:	0mm	
Integrated fire protection system in the unit	No fire detection and suppression system installed for the unit level test	
If the unit compliance with UL 1973 or UL 9540:	N/A	

Electrical rating					
Model:	SigenStack M2-0.5C-BST-4/48.23 kWh	SigenStack M2-0.5C-BST-5/60.29 kWh	SigenStack M2-0.5C-BST-6/72.35 kWh	SigenStack M2-0.5C-BST-7/84.4 kWh	SigenStack M2-0.5C-BST-8/96.46 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	48.23	60.29	72.35	84.4	96.46
Nominal voltage (V):	153.6	192	230.4	268.8	307.2
Weight(kg):	500	605.5	711	816.5	922
Module series and/or parallel configuration:	4S1P	5S1P	6S1P	7S1P	8S1P
Total number of cells:	48	60	72	84	96
Standard charge method:					
Charge power (kW):	24.1152	30.144	36.1728	42.2016	48.2304
End of charge voltage (V):	170.4	213	255.6	298.2	340.8
Standard discharge method:					
Discharge power (kW):	24.1152	30.144	36.1728	42.2016	48.2304
End of discharge voltage (V):	139.2	174	208.8	243.6	278.4

Model:	SigenStack M2-0.5C-BST-9/108.52 kWh	SigenStack M2-0.5C-BST-10/120.58 kWh	SigenStack M2-0.5C-BST-11/132.63 kWh	SigenStack M2-0.5C-BST-12/144.69 kWh	SigenStack M2-0.5C-BST-13/156.75 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	108.52	120.58	132.63	144.69	156.75
Nominal voltage (V):	345.6	384	422.4	460.8	499.2
Weight(kg):	1027.5	1133	1238.5	1344	1449.5
Module series and/or parallel configuration:	9S1P	10S1P	11S1P	12S1P	13S1P
Total number of cells:	108	120	132	144	156
Standard charge method:					
Charge power (kW):	54.2592	60.288	66.3168	72.3456	78.3744
End of charge voltage (V):	383.4	426	468.6	511.2	553.8
Standard discharge method:					
Discharge power (kW):	54.2592	60.288	66.3168	72.3456	78.3744
End of discharge voltage (V):	313.2	348	382.8	417.6	452.4

Model:	SigenStack M2-0.5C-BST-14/168.81 kWh	SigenStack M2-0.5C-BST-15/180.86 kWh	SigenStack M2-0.5C-BST-16/192.92 kWh	SigenStack M2-0.5C-BST-17/204.98 kWh	SigenStack M2-0.5C-BST-18/217.04 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	168.81	180.86	192.92	204.98	217.04
Nominal voltage (V):	537.6	576	614.4	652.8	691.2
Weight(kg):	1555	1660.5	1766	1871.5	1977
Module series and/or parallel configuration:	14S1P	15S1P	16S1P	17S1P	18S1P
Total number of cells:	168	180	192	204	216
Standard charge method:					
Charge power (kW):	84.4032	90.432	96.4608	102.4896	108.5184
End of charge voltage (V):	596.4	639	681.6	724.2	766.8
Standard discharge method:					
Discharge power (kW):	84.4032	90.432	96.4608	102.4896	108.5184
End of discharge voltage (V):	487.2	522	556.8	591.6	626.4

Model:	SigenStack M2-0.5C-BST-19/229.09 kWh	SigenStack M2-0.5C-BST-20/241.15 kWh	SigenStack M2-0.5C-BST-21/253.21 kWh	SigenStack M2-0.5C-BST-22/265.27 kWh	SigenStack M2-0.5C-BST-23/277.32 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	229.09	241.15	253.21	265.27	277.32
Nominal voltage (V):	729.6	768	806.4	844.8	883.2
Weight(kg):	2082.5	2188	2293.5	2399	2504.5
Module series and/or parallel configuration:	19S1P	20S1P	21S1P	22S1P	23S1P
Total number of cells:	228	240	252	264	276
Standard charge method:					
Charge power (kW):	114.5472	120.576	125	125	125
End of charge voltage (V):	809.4	852	894.6	937.2	979.8
Standard discharge method:					
Discharge power (kW):	114.5472	120.576	125	125	125
End of discharge voltage (V):	661.2	696	730.8	765.6	800.4

Model:	SigenStack M2-0.5C-BST-24/289.38 kWh	SigenStack M2-0.5C-BST-25/301.44 kWh	SigenStack M2-0.5C-20/241.15 kWh	SigenStack M2-0.5C-21/253.21 kWh	SigenStack M2-0.5C-22/265.27 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	289.38	301.44	241.15	253.21	265.27
Nominal voltage (V):	921.6	960	768	806.4	844.8
Weight(kg):	2610	2715.5	2188	2293.5	2399
Module series and/or parallel configuration:	24S1P	25S1P	20S1P	21S1P	22S1P
Total number of cells:	288	300	240	252	264
Standard charge method:					
Charge power (kW):	125	125	120.576	125	125
End of charge voltage (V):	1022.4	1065	852	894.6	937.2
Standard discharge method:					
Discharge power (kW):	125	125	120.576	125	125
End of discharge voltage (V):	835.2	870	696	730.8	765.6

Model:	SigenStack M2-0.5C-23/277.32 kWh	SigenStack M2-0.5C-24/289.38 kWh	SigenStack M2-0.5C-25/301.44 kWh	SigenStack M2-1C-BST-4/48.23 kWh	SigenStack M2-1C-BST-5/60.29 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	277.32	289.38	301.44	48.23	60.29
Nominal voltage (V):	883.2	921.6	960	153.6	192
Weight(kg):	2504.5	2610	2715.5	500	605.5
Module series and/or parallel configuration:	23S1P	24S1P	25S1P	4S1P	5S1P
Total number of cells:	276	288	300	48	60
Standard charge method:					
Charge power (kW):	125	125	125	48.23	60.29
End of charge voltage (V):	979.8	1022.4	1065	170.4	213
Standard discharge method:					
Discharge power (kW):	125	125	125	48.23	60.29
End of discharge voltage (V):	800.4	835.2	870	139.2	174

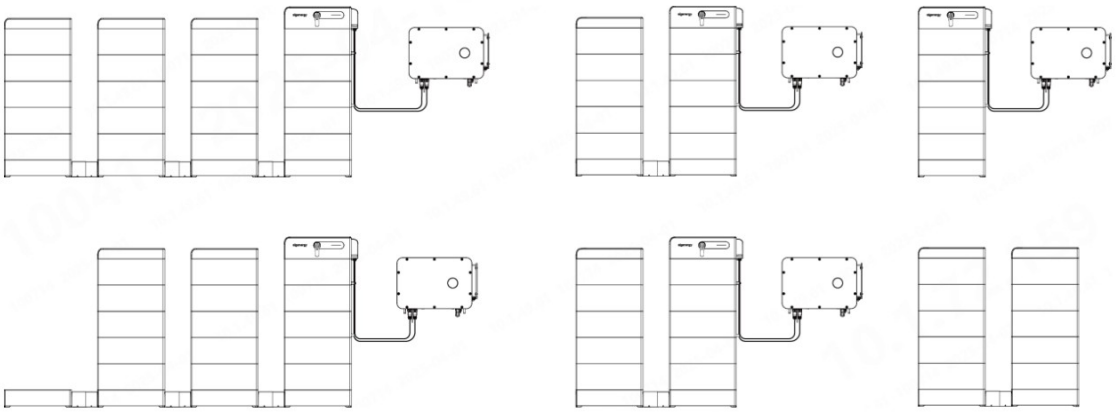
Model:	SigenStack M2-1C-BST-11/132.63 kWh	SigenStack M2-1C-BST-12/144.69 kWh	SigenStack M2-1C-BST-13/156.75 kWh	SigenStack M2-1C-BST-14/168.81 kWh	SigenStack M2-1C-BST-15/180.86 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	132.63	144.69	156.75	168.81	180.86
Nominal voltage (V):	422.4	460.8	499.2	537.6	576
Weight(kg):	1238.5	1344	1449.5	1555	1660.5
Module series and/or parallel configuration:	11S1P	12S1P	13S1P	14S1P	15S1P
Total number of cells:	132	144	156	168	180
Standard charge method:					
Charge power (kW):	125	125	125	125	125
End of charge voltage (V):	468.6	511.2	553.8	596.4	639
Standard discharge method:					
Discharge power (kW):	125	125	125	125	125
End of discharge voltage (V):	382.8	417.6	452.4	487.2	522

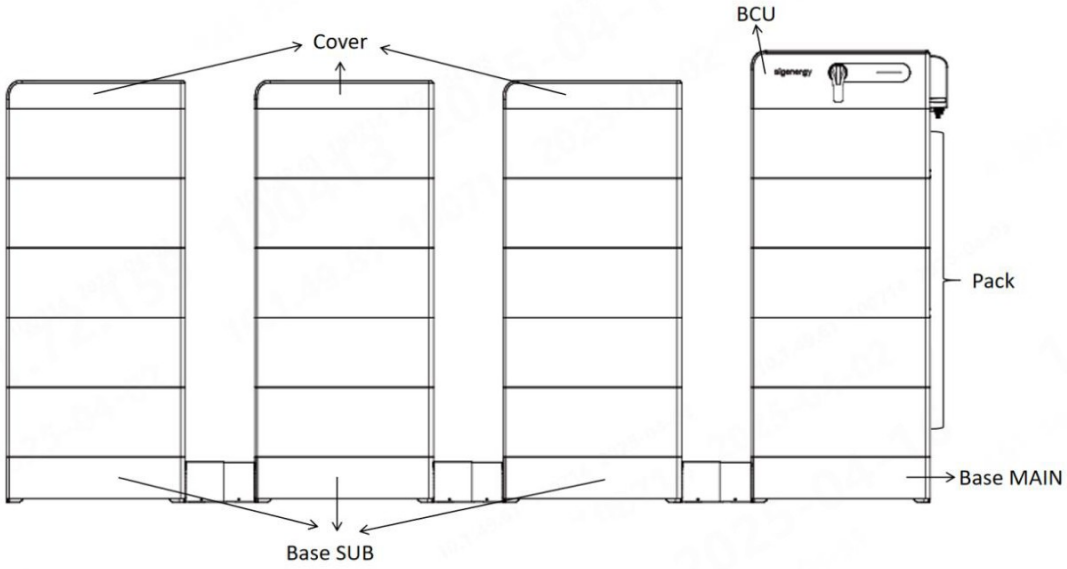
Model:	SigenStack M2-1C-BST-6/72.35 kWh	SigenStack M2-1C-BST-7/84.4 kWh	SigenStack M2-1C-BST-8/96.46 kWh	SigenStack M2-1C-BST-9/108.52 kWh	SigenStack M2-1C-BST-10/120.58 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	72.35	84.4	96.46	108.52	120.58
Nominal voltage (V):	230.4	268.8	307.2	345.6	384
Weight(kg):	711	816.5	922	1027.5	1133
Module series and/or parallel configuration:	6S1P	7S1P	8S1P	9S1P	10S1P
Total number of cells:	72	84	96	108	120
Standard charge method:					
Charge power (kW):	72.35	84.4	96.46	108.52	120.58
End of charge voltage (V):	255.6	298.2	340.8	383.4	426
Standard discharge method:					
Discharge power (kW):	72.35	84.4	96.46	108.52	120.58
End of discharge voltage (V):	208.8	243.6	278.4	313.2	348

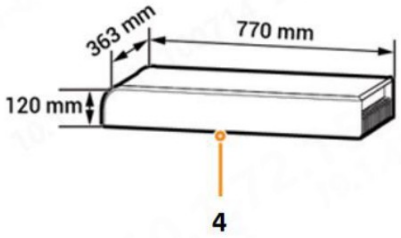
Model:	SigenStack M2-1C-BST-16/192.92 kWh	SigenStack M2-1C-BST-17/204.98 kWh	SigenStack M2-1C-BST-18/217.04 kWh	SigenStack M2-1C-BST-19/229.09 kWh	SigenStack M2-1C-BST-20/241.15 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	192.92	204.98	217.04	229.09	241.15
Nominal voltage (V):	614.4	652.8	691.2	729.6	768
Weight(kg):	1766	1871.5	1977	2082.5	2188
Module series and/or parallel configuration:	16S1P	17S1P	18S1P	19S1P	20S1P
Total number of cells:	192	204	216	228	240
Standard charge method:					
Charge power (kW):	125	125	125	125	125
End of charge voltage (V):	681.6	724.2	766.8	809.4	852
Standard discharge method:					
Discharge power (kW):	125	125	125	125	125
End of discharge voltage (V):	556.8	591.6	626.4	661.2	696

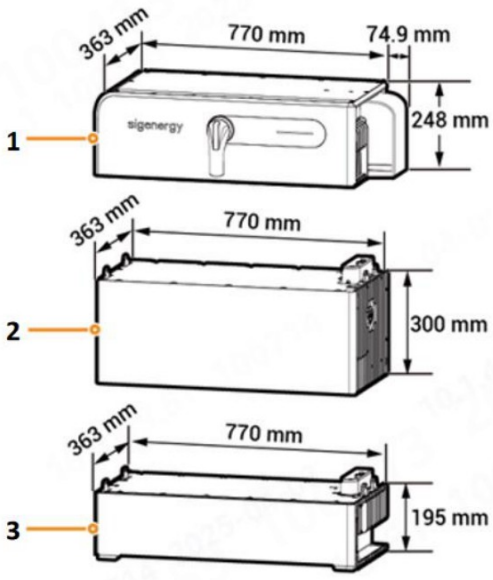
Model:	SigenStack M2-1C-BST-21/253.21 kWh	SigenStack M2-0.5C-BST-22/265.27 kWh	SigenStack M2-1C-BST-23/277.32 kWh	SigenStack M2-1C-BST-24/289.38 kWh	SigenStack M2-1C-BST-25/301.44 kWh
Rated capacity (Ah):	314	314	314	314	314
Rated energy (kWh):	253.21	265.27	277.32	289.38	301.44
Nominal voltage (V):	806.4	844.8	883.2	921.6	960
Weight(kg):	2293.5	2399	2504.5	2610	2715.5
Module series and/or parallel configuration:	21S1P	22S1P	23S1P	24S1P	25S1P
Total number of cells:	252	264	276	288	300
Standard charge method:					
Charge power (kW):	125	125	125	125	125
End of charge voltage (V):	894.6	937.2	979.8	1022.4	1065
Standard discharge method:					
Discharge power (kW):	125	125	125	125	125
End of discharge voltage (V):	730.8	765.6	800.4	835.2	870

Diagram of unit with overall dimension (Unit: mm)



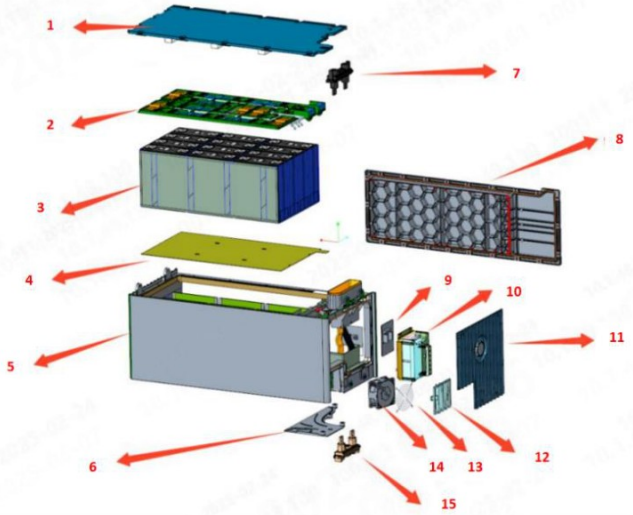






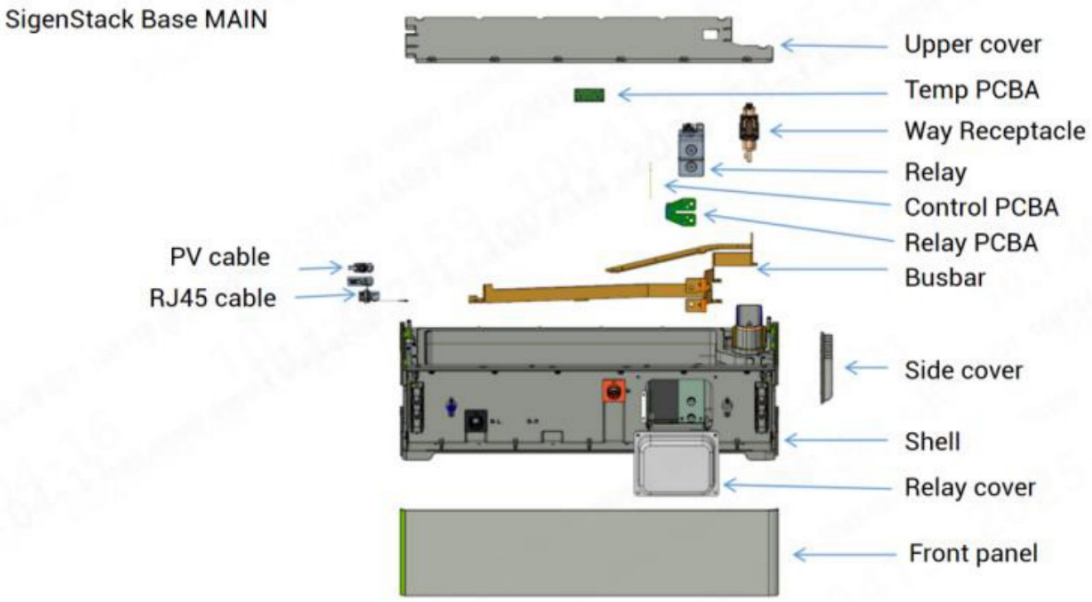
1.BCU
2.Pack
3.Base
4.Cover

Contents (main components) of the module
For battery module:

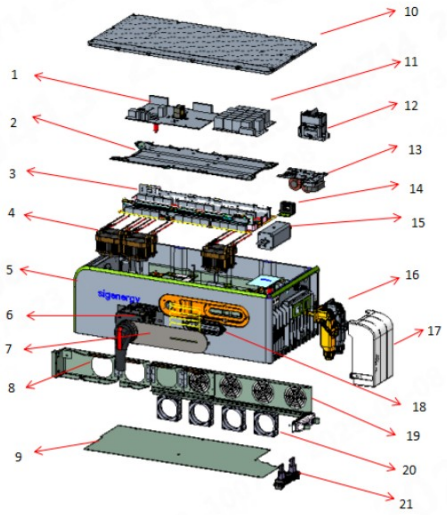


PACK					
1	Upper Cover	8	Rear Cover	15	Lower Floating Plug
2	Cell Connection System	9	Transition Board		
3	Battery Cell	10	Battery Management System		
4	Heating Film	11	Right Cover		
5	Housing	12	Outlet Guard		
6	Air Duct Guard	13	Fan Guard		
7	Upper Floating Plug	14	Fan		

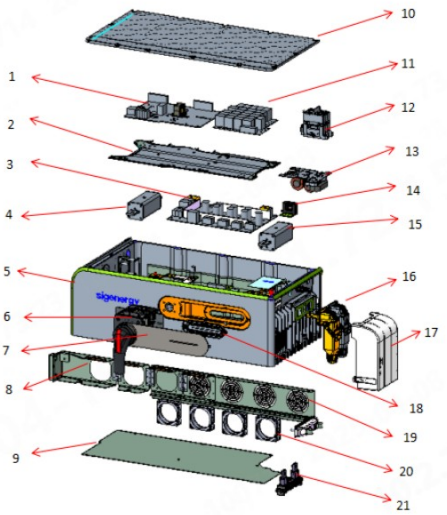
For base support:



For BCU:



SigenStack BC M2-1C-BST / SigenStack BC M2-0.5C-BST					
1	Control Board	8	Fan Component	15	Fuse
2	Intermediate Partition Board	9	Air Duct Cover	16	DT Terminal
3	Power Board	10	Cover	17	Wiring Cover
4	Inductor	11	Capacitor Board	18	Light Guide Plate
5	Housing	12	Relay	19	Fan Guide Rail
6	Switch	13	EMI Board	20	Fan
7	Display Board	14	Hall Board	21	Floating Plug



SigenStack BC M2-0.5C					
1	Control Board	8	Fan Component	15	Fuse
2	Intermediate Partition Board	9	Air Duct Cover	16	DT Terminal
3	Power Board	10	Cover	17	Wiring Cover
4	Fuse	11	Capacitor Board	18	Light Guide Plate
5	Housing	12	Relay	19	Fan Guide Rail
6	Switch	13	EMI Board	20	Fan
7	Display Board	14	Hall Board	21	Floating Plug

Photo of the unit

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
5	**Construction – General**		
5.1	**Cell**		--
5.1.1	The cell info associated with the BESS includes:		P
	• cell chemistry (e.g. NMC, LFP);	$LiFePO_4$	P
	• the physical format of the cell;	Prismatic	P
	• the cell electrical rating in capacity and nominal voltage;	3.2V, 314Ah	P
	• the overall dimensions of the cell, and weight.	See page 4-5	P
5.1.2	The cells associated with the BESS comply with ANSI/CAN/UL 1973 or not.	Certificate provided.	P
5.1.3	Further details included in the cell level test report.		P
5.2	**Module**		--
5.2.1	The modules info associated with the BESS includes:		P
	• the generic enclosure material;	Metal	P
	• the general layout of the module contents;	See page 6-10	P
	• the electrical configuration of the cells in the modules and the modules in the BESS.	1P12S	P
5.2.2	The modules associated with the BESS comply with UL 1973 or not.		N/A
5.2.3	Further details included in the module level test report.	Refer to 8.3	P
5.3	**Battery energy storage system unit**		--
5.3.1	The BESS unit info includes:		--
	• the units comply with UL 9540 or not;		N/A
	• the manufacturer and model number;		P
	• electrical ratings;		P
	• energy capacity of all BESS.		P
5.3.2	For BESS units, which UL 9540 compliance cannot be determined, to include:		--
	• the number of modules in the BESS;	4~25	P
	• electrical configuration of the module;		P
	• physical layout of the modules in the BESS;		P
	• battery management system (BMS); and		P
	• other major components of the BESS;		P
	• the BESS enclosure overall dimensions and generic material;		P
	• battery system(s) may be tested as representative of the BESS;		P
	• battery system complies with UL 1973 or not.		N/A
5.3.3	Any fire detection and suppression systems that are an integral part of the BESS.	No fire detection and suppression system installed for the test.	N/A
5.3.4	Further details included in the unit level and if applicable, installation level test reports.		P
5.4	**Flow Batteries**		--

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
5.4.1	For flow batteries, to include the following info:		N/A
	• the chemistry;		N/A
	• a generic description of the electrolyte (s);		N/A
	• the overall dimensions of the individual stack;		N/A
	• the electrical rating in capacity and nominal voltage of the cell stack.		N/A
	And the Information of the complete flow battery system:		N/A
	• the manufacturer's name and model number of the system;		N/A
	• the electrical rating in volts and rated storage capacity in Ah or Wh;		N/A
	• the number of cells and stacks in the system;		N/A
	• the maximum volume of electrolyte(s) for the system.		N/A
5.4.2	The flow battery system complies with UL 1973 or not.		N/A
5.4.3	Further details included in the flow battery thermal runaway determination level test report.		N/A
6	**Performance – General**		
6.1	The tests in this standard are extreme abuse conditions conducted on electrochemical energy storage devices, which may result in various kind of hazards.		P
6.2	At the conclusion of testing, samples discharged in accordance with the manufacturer' specifications.		P
	All samples disposed of in accordance with local regulations.		P
9	**Unit Level**		
9.1	**Sample and test configuration**		**--**
9.1.1	The unit level test shall be conducted with BESS units installed as described in the manufacturer's instructions and this section.		P
9.1.2	The unit level test requires one initiating BESS unit and target adjacent BESS unit’s representative of an installation.		P
	(Modified by UL CRD-2020.10.21) Tests conducted for indoor floor mounted installations for residential BESS may be considered representative of both indoor floors mounted and outdoor ground mounted installations.		P
	Exception: Testing can be conducted outdoors for outdoor only installations with controlled environment.		N/A
9.1.3	Depending upon the configuration and design of the BESS (e.g. the BESS is composed of multiple separate parts within separate enclosures), this testing to determine fire characterization can be done at the battery system level.		P
9.1.4	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.		P

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
9.1.5	Target BESS units shall include the outer cabinet, racking, module enclosures, and components that retain cells components. The target BESS unit module enclosures do not need to contain cells.	No cells in target BESS	P
9.1.6	The initiating BESS unit shall be at the maximum operating state of charge (MOSOC) for conducting the tests in this standard. After charging and prior to testing, the initiating BESS shall rest for a maximum period of 8h at room ambient.	See attachment 2: sample preparation.	P
9.1.7	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.		N/A
9.1.8	Electronics and software controls such as the battery management system (BMS) in the BESS are not relied upon for this testing.	BMS function disabled	P
	This does not include a fire suppression control in accordance with UL 840 that is external to the BESS, but provided as part of an integral fire suppression system per 9.1.7.		N/A
9.2	**Test method – Indoor floor mounted BESS units**		**--**
9.2.1	During the test, the test room environment shall be controlled to prevent drafts that may affect test results.	See attachment 5	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.		P
9.2.3	The initiating BESS unit shall be positioned adjacent to two instrumented wall sections.	See attachment 3	P
9.2.4	Instrumented wall sections shall extend not less than 0.49m horizontally beyond the exterior of the target BESS units.		P
9.2.5	Instrumented wall sections shall be at least 0.61m taller than the BESS unit height, but not less than 3.66m in height above the bottom surface of the unit.		P
9.2.6	The surface of the instrumented wall sections shall be covered with 16-mm (5/8-in) gypsum wall board and painted flat black.		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 for the duration of the test, and the smoke release rate shall be calculated.		P
9.2.9	The chemical and convective heat release rates shall be measured for the duration of the test, respectively.		P
9.2.10	The heat release rate measurement system shall be calibrated 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	The convective heat release rate shall be measured using a thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust system of the exhaust duct.		P

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
9.2.12	The convective heat release rate shall be calculated using the following equation: $HRR_c = V_e A \frac{353.22}{T_e} \int_{T_a}^{T} C_p dT$	See attachment 9	P
9.2.13	The physical spacing between BESS units (both initiating and target) and adjacent walls shall be representative of the intended installation.	See attachment 3	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	See attachment 3	P
	b) Adjacent BESS units.	See attachment 3	P
9.2.15	Wall surface temperature measurements shall be collected for BESS intended for installation in locations with combustible construction.	See attachment 6	P
	If the intended installation is composed completely of noncombustible construction in which wall assemblies, cables, wiring and any other combustible materials are not to be present in the BESS installation, then the report should note that the installation shall contain no combustible construction and that surface temperature rises can be deemed not applicable.		N/A
9.2.16	Wall surface temperatures shall be measured in vertical array(s) at 152-mm (6-in) intervals for the full height of the instrumented wall sections.	Using #30-gauge, Type-K exposed junction thermocouples; See attachment 6	P
	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.		P
9.2.17	Thermocouples shall be secured to gypsum surfaces by the use of staples placed over the insulated portion of the wires.		P
	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
9.2.18	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt- Boelter gauges at the surface of each instrumented wall:	Cheesecloth used, refer to 9.2.18.1, heat flux measurement on walls was not measured.	N/A
	a) Both are collinear with the vertical thermocouple array;		N/A
	b) One is positioned at the elevation estimated to receive the greatest heat flux due to the thermal runaway of the initiating module; and		N/A
	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.		N/A
9.2.18.1	Heat flux measurements on walls may be waived for residential units that are tested with the cheesecloth indicator of 9.2.22.	Cheesecloth indicator used.	P

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Clause	Requirement – Test	Result - Remark	Verdict
9.2.18.2	(added by UL CRD-2021.03.26) With reference to 9.2.18, if b) and c) are deemed to be at the same location, only one gauge may be installed on the wall for the measurement.		N/A
9.2.19	Heat flux shall be measured with the sensing element of at least two water-cooled Schmidt-Boelter gauges at the surface of each adjacent target BESS unit that faces the initiating BESS unit:		N/A
	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		N/A
	b) One is positioned at the elevation estimated to receive the greatest surface heat flux due to the thermal runaway of the initiating BESS.		N/A
9.2.19.1	(added by UL CRD-2021.03.26) Heat flux measurements on target units may be waived for residential units that are tested with the cheesecloth indicator of 9.2.22.		P
9.2.19.2	(added by UL CRD-2021.03.26) With reference to 9.2.19, if a) and b) are deemed to be at the same location, only one gauge may be installed on the target unit for the measurement.		N/A
9.2.20	(added by UL CRD-2021.03.26) For non-residential use BESS and outdoor ground mounted residential use BESS, 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 or the point where the majority of off-gas venting is expected from the initiating unit in the center of the accessible means of egress.		P
9.2.21	Measure the temperature of:		P
	the surface proximate to the cells and between the cells and exposed face of the initiating module;		P
	Each non-initiating module enclosure within the initiating BESS unit;		P
	Convoluted enclosure interior geometries.		P
9.2.22	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator.		P
9.2.23	An internal fire condition in accordance with the module level test shall be created within a single module in the initiating BESS unit:		P
	a) The position of the module shall be selected to present the greatest thermal exposure to adjacent modules, based on the results from the module level test; and		P
	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
9.2.24	The composition, velocity and temperature of the initiating BESS unit vent gases shall be measured within the calorimeter's exhaust duct.	Via the testing system which has the sensors in the exhaust duct	P

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
	Gas composition shall 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 ft), or equivalent gas analyzer.		P
	Composition, velocity and temperature instrumentation shall be collocated with heat release rate calorimetry instrumentation.		P
9.2.25	The hydrocarbon components of the vent gas composition shall be measured using flame ionization detection.	Integrated FID in the testing system used	P
9.2.26	The test shall be terminated if:		P
	a) Temperatures measured inside each module within the initiating BESS unit return to ambient temperature;		P
	b) The fire propagates to adjacent units or to adjacent walls; or		N/A
	c) A condition hazardous to test staff or the test facility requires mitigation.		N/A
9.2.27	For residential use systems, the gas collection data 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**		--
9.3.1	Outdoor ground mounted non-residential use BESS being evaluated for installation in close proximity to buildings and structures.		P
	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
9.3.2	Outdoor ground mounted residential use BESS being evaluated for installation in close proximity to buildings and structures.		P
	Heat flux measurements for the accessible means of egress.		P
	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.		P
	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.		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

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
9.3.4	Target BESS shall be installed on each side of the initiating BESS and keep the min. separation distances specified by the manufacturer.		P
9.4	**Test Method – Indoor wall mounted units**		**--**
9.4.1	Testing of indoor wall mounted BESS shall be in accordance with Section 9.2, except as modified in this section.		N/A
9.4.2	Conduct testing in a standard NFPA 286 fire test room (12 x 8 x 8-ft) high, with a 2-1/2 x 7-ft high opening.		N/A
9.4.2.1	(Added by UL CRD-2020.10.21) BESS intended for residential installations only may be tested using instrumented wall sections not less than 2.44m (8-ft) in height & width instead of the test room.		N/A
9.4.3	The initiating BESS unit shall be positioned on the wall opposite of the door opening, with the center located 4-ft above the floor, and halfway between adjacent walls.		N/A
9.4.3.1	(added by UL CRD-2020.10.21) When residential BESS are tested in accordance with 9.4.2.1, the initiating BESS unit shall be positioned with the center located 1.22m (4-ft) above the floor, 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.		N/A
9.4.5	The wall on which the initiating and target BESS units are mounted shall be instrumented.		N/A
9.4.6	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.		N/A
9.4.8	(added by UL CRD-2020.10.21) When testing BESS for residential only installations, the criteria in 9.2.9. 9.2.18 and 9.2.19 may be waived.		N/A
9.5	**Test Method – Outdoor wall mounted units**		**--**
9.5.1	Testing of outdoor wall mounted BESS shall be in accordance with Section 9.2, except as modified in this section.		N/A
	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.		N/A
9.5.2	Test samples shall be mounted on an instrumented wall (undersurface of the eave shown in Figure 9.4).		N/A
9.5.3	The initiating BESS unit shall be positioned on the instrumented wall, with its center located 4-ft 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 and keep the min. separation distances specified by the manufacturer.		N/A

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
9.5.5	The wall on which the initiating and target BESS units are mounted shall be instrumented.		N/A
9.5.6	For residential use BESS, the DUT shall be covered with a single layer of cheese cloth ignition indicator.		N/A
9.6	**Rooftop and open garage installations**		P
9.6.1	Testing of BESS intended for non-residential use rooftop or open garage installations shall be in accordance with 9.2.		P
9.6.2	If intended for rooftop and open 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.		P
9.7	**Unit level test report**		**--**
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
	i) Rooftop installed non-residential use BESS; or		P
	j) Open garage installed non-residential use BESS.		P
9.7.2	If testing is intended to represent more than one installation type, this shall be noted in the report.		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);	See unit information	P
	b) Number of modules in the initiating BESS unit;	See Attachment 3	P
	c) The construction of the initiating BESS unit per 5.3;	See unit information	P
	d) Fire protection features/detection/suppression systems within unit;	No fire detection and suppression system installed for the test.	N/A
	e) Module voltage(s) corresponding to the tested SOC;	See Attachment 2	P
	f) The thermal runaway initiation method used;	See Attachment 4	P
	g) Location of the initiating module within the BESS unit;	See Attachment 3	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, and soffits;	See Attachment 3	P
	i) Observation of any flaming outside the initiating BESS enclosure and the maximum flame extension;	See Attachment 5	P

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
	j) Chemical and convective heat release rate versus time data;	See Attachment 8 and attachment 9	P
	k) Separation distances from the initiating BESS unit to target walls (A and C in Figure 9.1);	See Attachment 3	P
	l) Separation distances from the initiating BESS unit to target BESS units (D and H in Figure 9.1);	See Attachment 3	P
	m) The maximum wall surface and target BESS temperatures achieved during the test and the location of the measuring thermocouple;	See Attachment 6	P
	n) 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 6	P
	o) The maximum incident heat flux on target wall surfaces and target BESS units;	Cheesecloth used, refer to 9.2.18.1, heat flux measurement on walls was not measured.	N/A
	p) The maximum incident heat flux on target ceiling or soffit surfaces achieved during the indoor or outdoor wall mounted test;	Cheesecloth used, refer to 9.2.18.1, heat flux measurement on walls was not measured.	N/A
	q) Gas generation and composition data	See Attachment 10	P
	r) Peak smoke release rate and total smoke release data;	See Attachment 11	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 system installed for the test.	N/A
	t) Observation of flying debris or explosive discharge of gases;	No observation.	P
	u) Observation of re-ignition(s) from thermal runaway events;	No observation.	P
	v) Observation(s) of sparks, electrical arcs, or other electrical events;	See Attachment 5	P
	w) Observations of the damage to:	See Attachment 1	P
	1) The initiating BESS unit;	See Attachment 1	P
	2) Target BESS units;	See Attachment 1	P
	3) Adjacent walls, ceilings, or soffits; and	See Attachment 1	P
	x) Photos and video of the test.	See Attachment 1 and 20250315-1.mp4 to 20250315-9.mp4	P
9.8	**Performance at unit level testing**		--
9.8.1	Installation level testing in Section 10 is not required if the performance conditions outlined in Table 9.1 are met during the unit level test.		P
	Non-Residential Installations		--
Indoor Floor Mounted	a) Flaming outside the initiating BESS unit is not observed;	Not observed.	P
	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 7.3.1.8;		P
	c) For BESS units intended for installation in locations with combustible constructions, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		P

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and	Not observed.	P
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		P
Outdoor Ground Mounted	a) If flaming outside of the unit is observed, separation distances to exposures shall be determined by greatest flame extension observed during test.	Not observed	P
	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 7.3.1.8;		P
	c) For BESS units intended for installation near exposures, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		P
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and	Not observed.	P
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		P
Indoor Wall Mounted	a) Flaming outside the initiating BESS unit is not observed;		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 7.3.1.8;		N/A
	c) For BESS units intended for installation in locations with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		N/A
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		N/A
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		N/A
Outdoor Wall Mounted	a) Flaming outside the initiating BESS unit is not observed;		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 7.3.1.8;		N/A
	c) For BESS units intended for installation on walls with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		N/A

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		N/A
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		N/A
Rooftop and Open Garages	a) If flaming outside the unit is observed, separation distances to exposures shall be determined by greatest flame extension observed during test;		P
	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 7.3.1.8;		P
	c) For BESS units intended for installation in locations with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		P
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		P
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		P
	Residential Installations		--
Indoor Floor Mounted	a) Flaming outside the initiating BESS unit is not observed as demonstrated by no flaming or charring of the cheesecloth indicator;		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 7.3.1.8;		N/A
	c) For BESS units intended for installation in locations with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		N/A
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		N/A
	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) If flaming outside of the unit is observed, separation distances to exposures shall be determined by greatest flame extension observed during test.		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 7.3.1.8;		N/A

ANSI/CAN/UL 9540A			
Clause	Requirement – Test	Result - Remark	Verdict
	c) For BESS units intended for installation near exposures, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		N/A
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		N/A
	e) Heat flux in the center of the accessible means of egress shall not exceed 1.3 kW/m2.		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;		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 7.3.1.8;		N/A
	c) For BESS units intended for installation in locations with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15;		N/A
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases; and		N/A
	e) The concentration of flammable gas does not exceed 25% LFL for the smallest intended room installation size.		N/A
Outdoor Wall Mounted	a) Flaming outside the initiating BESS unit is not observed as demonstrated by no flaming or charring of the cheesecloth indicator;		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 7.3.1.8;		N/A
	c) For BESS units intended for installation in locations with combustible construction, surface temperature measurements on wall surfaces do not exceed 97°C of temperature rise above ambient per 9.2.15; and		N/A
	d) Explosion hazards are not observed, including deflagration, detonation or accumulation (to within the flammability limits in an amount that can cause a deflagration) of battery vent gases.		N/A

Attachment 1 Photos

The battery system before test

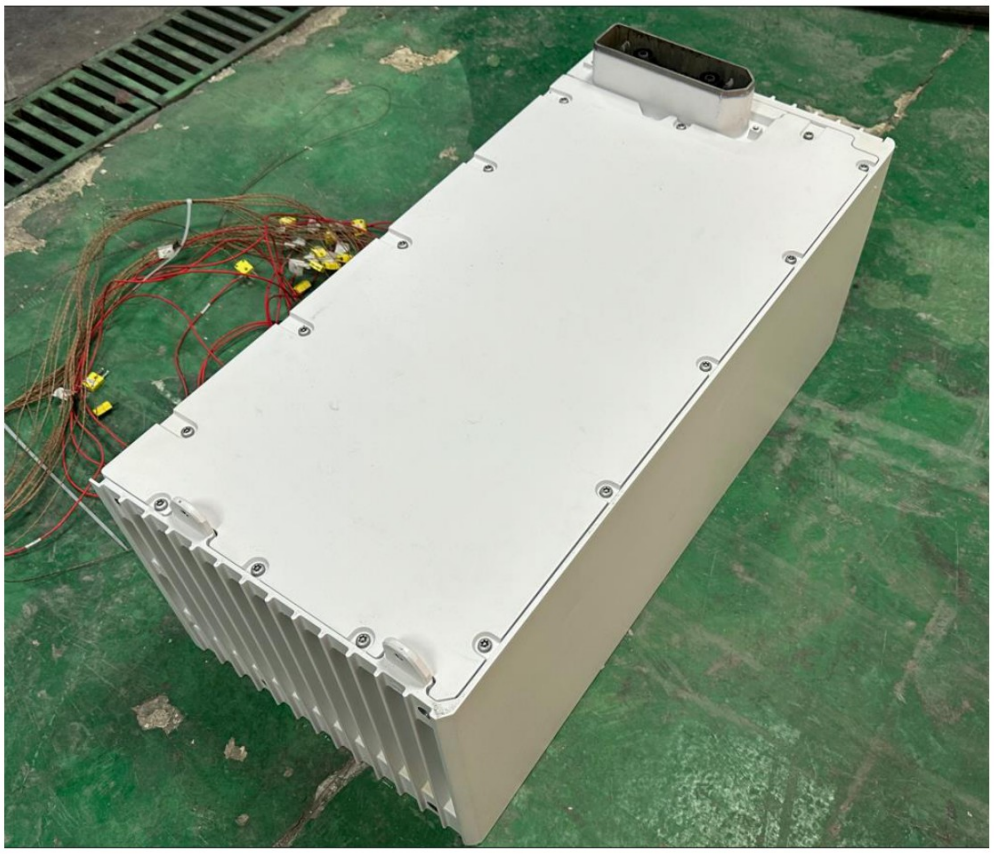
Front side

During test

Smoke release from initiating unit

The battery system after test

Internal view of initiating module, after test



Attachment 2 Sample preparation

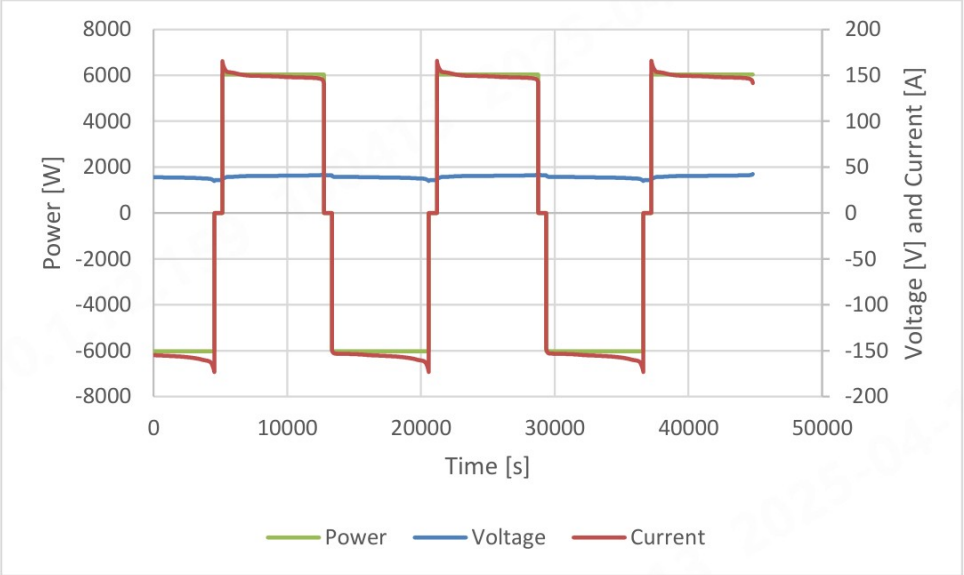
The test energy storage system consists of 25 modules.

The unit was conditioned, prior to testing, through charge and discharge cycles for 2 cycles per the manufacturer's instructions to verify that the unit was functional.

As manufacturer specified, the module was charged with 6.0288kW power to module end charge voltage 42.6V, then keep the module stabilized for 10 minutes. After being stabilized, the module was discharged, the module was discharged with 6.0288kW power to module end discharge voltage 34.8V, then keep the module stabilized for 10 minutes.

After repeating the cycle above twice and then unit was fully charged with 6.0288kW power to unit end charge voltage 42.6V, and before testing, the unit was stabilized for about 4 hours.
During conditioning the ambient temperature maintained in 25 ±5°C and 50 ±25% RH.

Cycling curve of the initiating unit is shown below.



Initiating unit charge and discharge voltage/current profiles

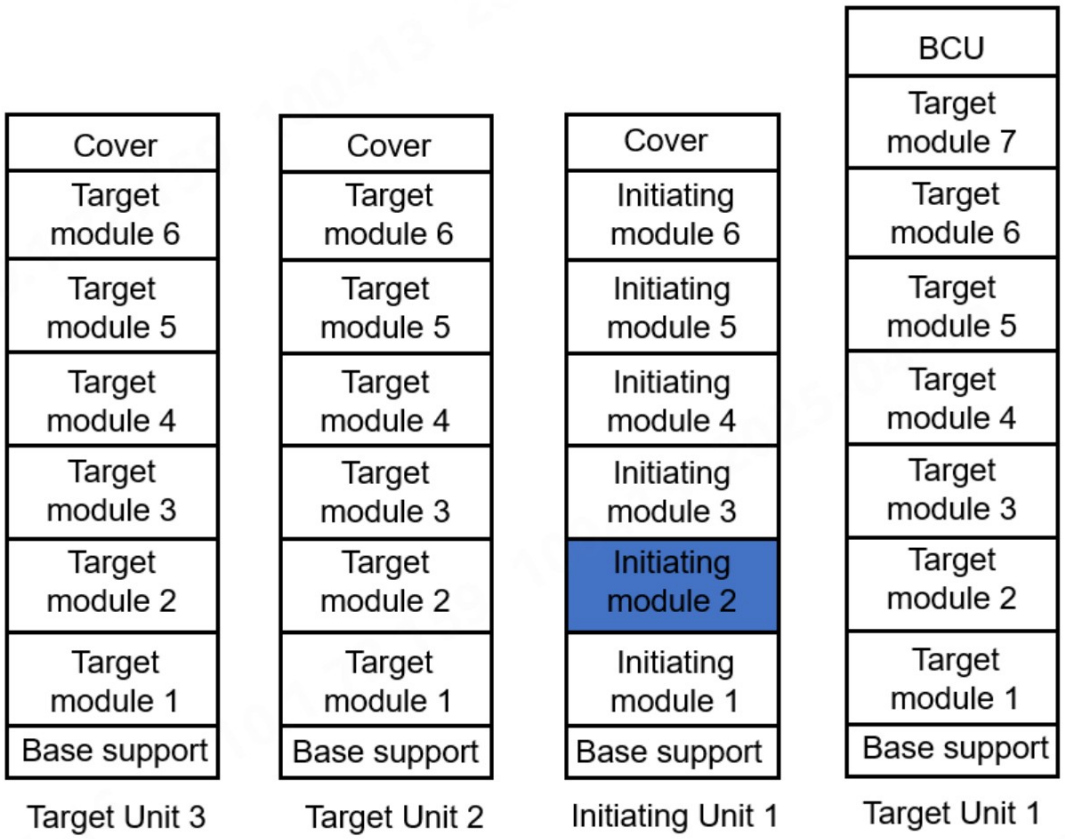
Attachment 3 Arrangement of the unit

The installation information was provided by the client as below.

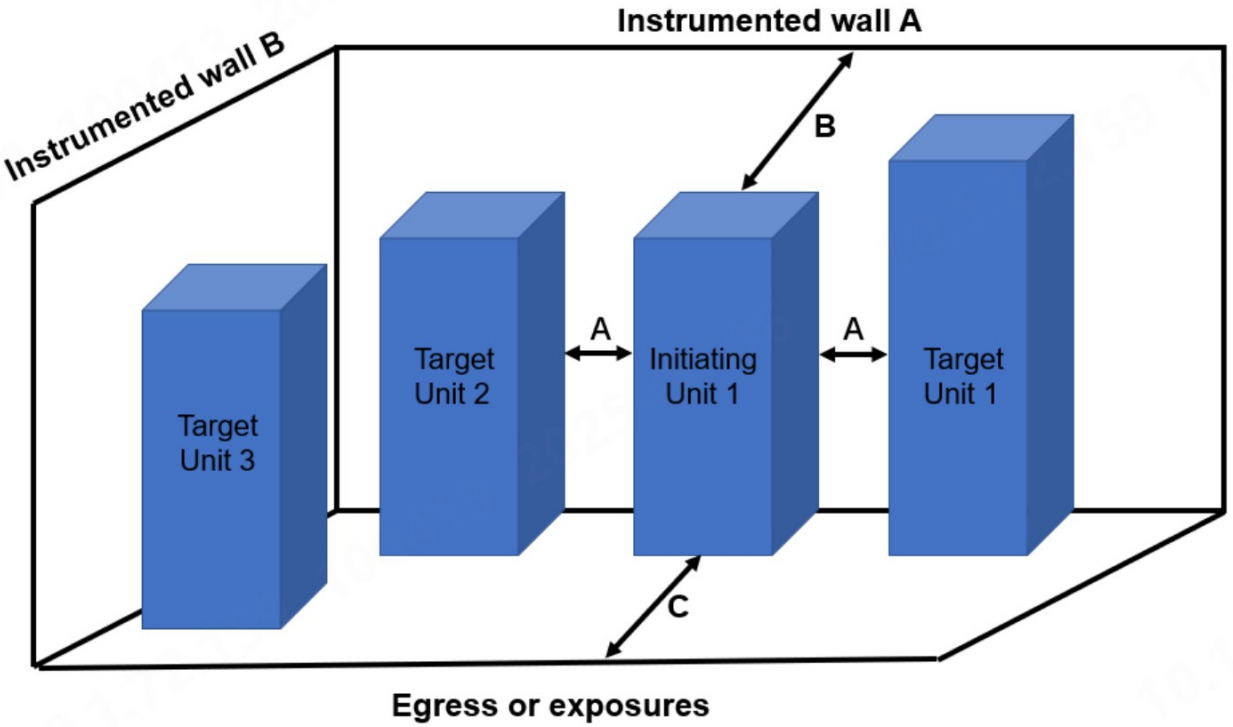
Intended use location .....:	☐ Residential	☒ Non-residential
	☒ Non-residential rooftop	
	☒ Non-residential open garage use	
Type of installation .....:	☒ Indoor floor mounted	☒ Outdoor ground mounted
	☐ Indoor wall mounted	☐ Outdoor wall mounted
Row(s) of installation	☐ Single	☒ Multiple

Walls were constructed of 16 mm (5/8-inch) gypsum painted flat black.

Two unit were used for the purpose of the test. To identify the modules in each unit, the modules in each unit were numbered as the figure below.



Minimum separation distance from the units to instrumental walls were shown in below figure. Top view of the unit arrangement and separation distance from units to instrumental walls are shown in below figure. Due the weight and size of the unit, the accuracy of the distance may have a 0.5 cm tolerance.



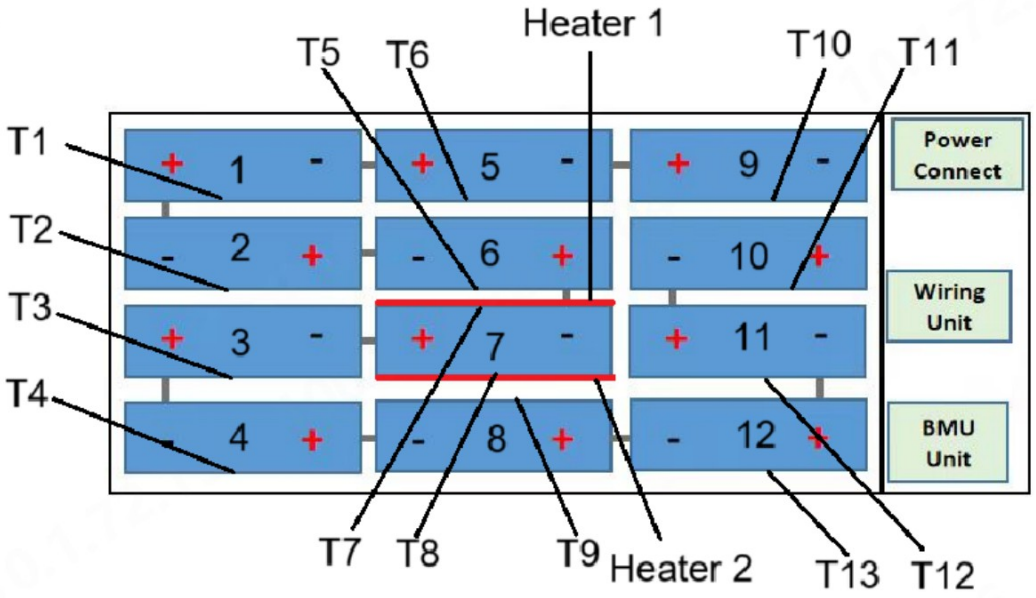
A= Distance from the initiating unit to target unit: min.30cm	B= Distance from the unit to instrumented wall A and B: min.10cm	C= Distance from the unit to egress or exposures: min.91.4cm

Attachment 4 Thermal runaway preparation

Initiating module 2 in initiating unit 1 was selected as the initiating module.

The initiating module was charged to 100% SOC and allowed to stabilize for a minimum of 1 h and a maximum of 8 h before the start of the test.

External heating method was used to initiate thermal runaway in the module. 2 flexible film heaters, rated 220VAC/880W each, sized 220mm x 180mm, were pasted on two big sides of cell 7.



Cell 7 was heated as the target cell at a rate of 4°C-7°C per minute until thermal runaway was occurred when thermal runaway occurred, the heater will de-energized immediately.

Attachment 5 Observations and records

Before the test, the initiating module 2 was charged to 100% SOC and stabilized for about 4 h before the start of the test.

Below table summarizes the details:

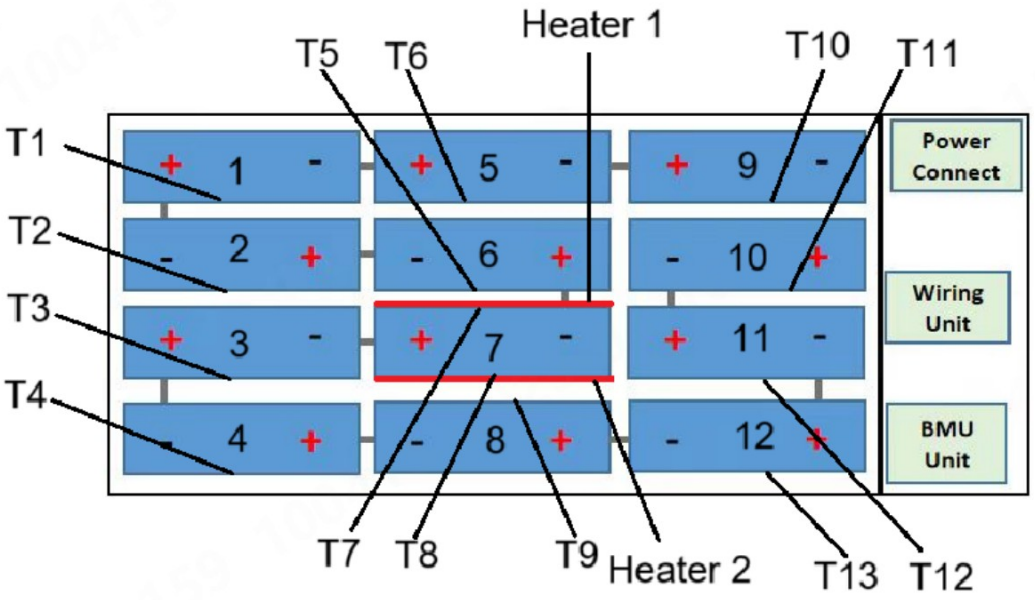
<table>
<tr><td>Ambient conditions at the initiation of the test:</td><td colspan="4">20.1°C, 70.2%RH</td></tr>
<tr><td>Electronics and software controls within the module?</td><td colspan="4">☒ Yes, but not relied upon for this testing
☐ No such controls</td></tr>
<tr><td>Time when test was initiated:</td><td colspan="4">15 March 2024, 14:00</td></tr>
<tr><td rowspan="5">Observations during test:</td><td>1st vented</td><td>14:52</td><td>1st thermal runaway</td><td>14:53</td></tr>
<tr><td>2nd vented</td><td>14:53</td><td>2nd thermal runaway</td><td>14:54</td></tr>
<tr><td>3rd vented</td><td>14:54</td><td>3rd thermal runaway</td><td>14:55</td></tr>
<tr><td>4th vented</td><td>15:30</td><td>4th thermal runaway</td><td>15:31</td></tr>
<tr><td colspan="4">No flying debris or explosive discharge of gases.
No sparks, electrical arcs, or other electrical events.
No external flaming was observed</td></tr>
<tr><td>Post-test evaluation:</td><td colspan="4">In initiating unit 1, no thermal runaway propagation from initiating module 2 to other modules in initiating unit.

In initiating module 2, cell 7 went to thermal runaway, due to external heating. Cell 5, cell 6 and cell 8 in the initiating module 2 vented and went to thermal runaway due to thermal runaway propagation.
Cell 2, cell 3, cell 4, cell 9, cell 10, cell 11 and cell 12 in the initiating module 2 vented.

No damage on target walls.
No damage on target units.</td></tr>
</table>

Attachment 6 Temperature measurements

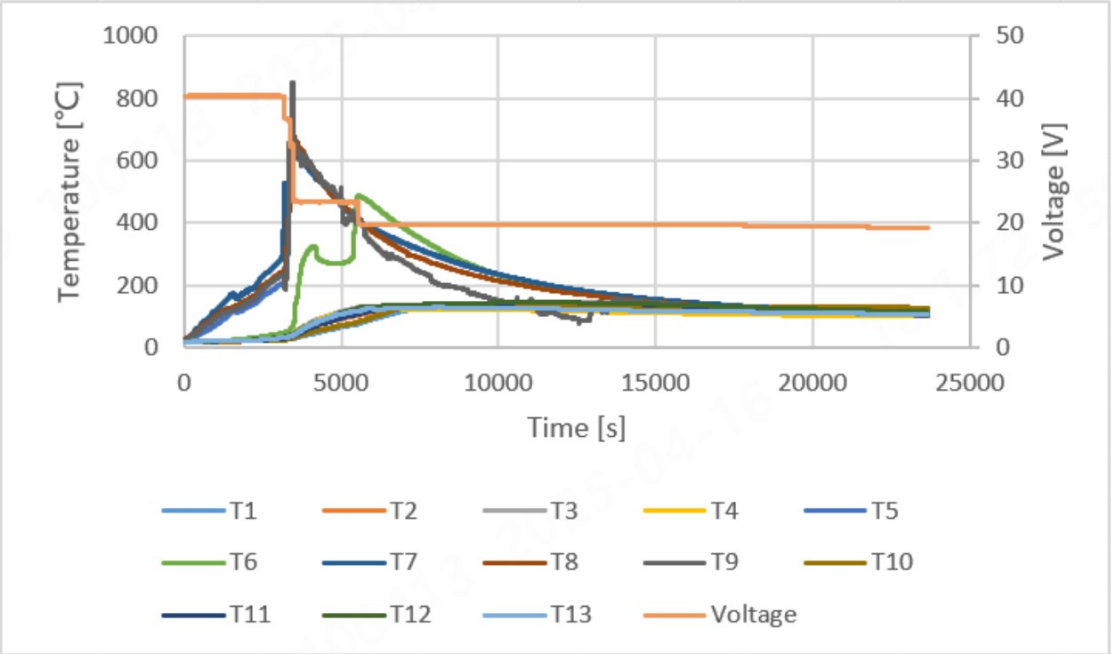
To monitor the cells temperature inside the initiating module 2, 13 thermocouples, Type K, were used. See below figure and table for detail location of the flexible heaters and thermocouples.



Heaters and thermocouple location inside the module

Thermocouple No.	Thermocouple location on initiating module 2
T1	Centre of big side of cell 1 facing cell 2
T2	Centre of big side of cell 2 facing cell 3
T3	Centre of big side of cell 3 facing cell 4
T4	Centre of big side of cell 4 facing enclosure
T5	Centre of big side of cell 6 facing heater 1
T6	Centre of big side of cell 5 facing cell 6
T7	Between center of big side of cell 7 and heater 1
T8	Between center of big side of cell 7 and heater 2
T9	Centre of big side of cell 8 facing heater 2
T10	Centre of big side of cell 9 facing cell 10
T11	Centre of big side of cell 10 facing cell 11
T12	Centre of big side of cell 11 facing cell 12
T13	Centre of big side of cell 12 facing enclosure

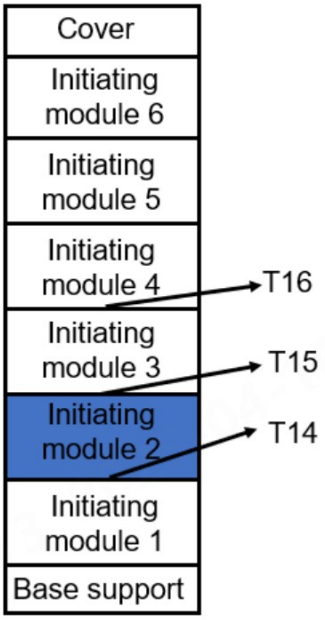
Temperature describing cell to cell propagation in initiating module 2 voltage are show in below figure.



The maximum measured temperature of each location is shown in below table.

Thermocouple No.	Thermocouple location on initiating module 3	Maximum temperature (°C)
T1	Centre of big side of cell 1 facing cell 2	136.6
T2	Centre of big side of cell 2 facing cell 3	143.4
T3	Centre of big side of cell 3 facing cell 4	145.3
T4	Centre of big side of cell 4 facing enclosure	123.0
T5	Centre of big side of cell 6 facing heater 1	657.9
T6	Centre of big side of cell 5 facing cell 6	489.7
T7	Between center of big side of cell 7 and heater 1	645.0
T8	Between center of big side of cell 7 and heater 2	688.0
T9	Centre of big side of cell 8 facing heater 2	847.4
T10	Centre of big side of cell 9 facing cell 10	138.7
T11	Centre of big side of cell 10 facing cell 11	144.2
T12	Centre of big side of cell 11 facing cell 12	144.4
T13	Centre of big side of cell 12 facing enclosure	129.0
Max. system voltage, after test		
Voltage	19.2V	

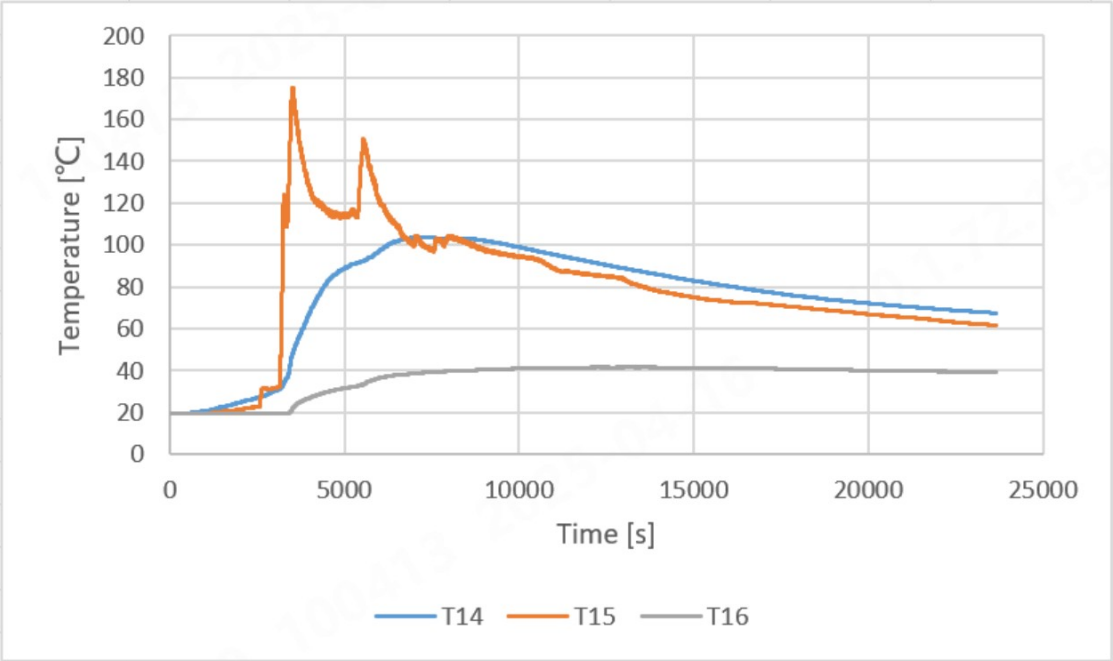
To monitor the surface temperature of initiating module 1, initiating module 2 and initiating module 3 in initiating unit 1, 3 thermocouples (number T14 to T16) were used, and detail location was shown in below figure and table.



Initiating Unit 1

Thermocouple's location in initiating module (Front View)

The measured surface temperature of initiating module 1, initiating module 2 and initiating module 3 in initiating unit 1 during test is shown in below figure.



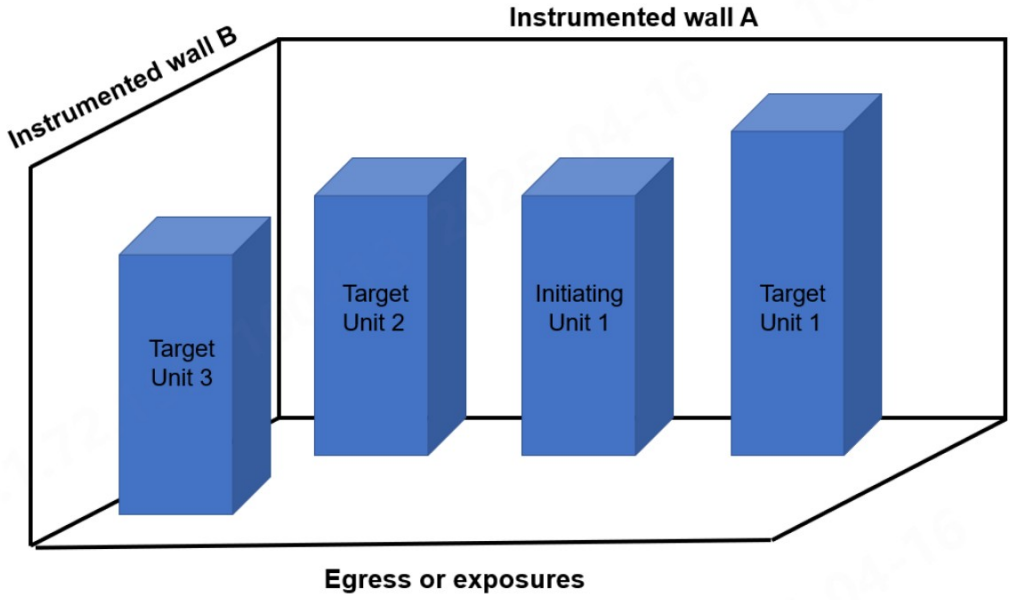
The maximum measured temperature of each location is shown in below table.

Thermocouple No.	Location	Maximum measured temperature (°C)
T14	Metal enclosure, top of the initiating module 1	103.6
T15	Metal enclosure, top of the initiating module 2	175.1
T16	Metal enclosure, top of the initiating module 3	41.6

To monitor the surface temperature of instrumental walls, vertical array at 152 mm intervals for the full height of the instrumented wall sections using Type K, 30 AWG thermocouples were used.

The thermocouple array A was on instrumental wall A, collinear with vertical central line of initiating unit 1 back surface.
The thermocouple array B was on the left enclosure surface of target unit 1, collinear with vertical central line of initiating unit 1 right surface.
The thermocouple array C was on the right enclosure surface of target unit 2, collinear with vertical central line of initiating unit 1 left surface.

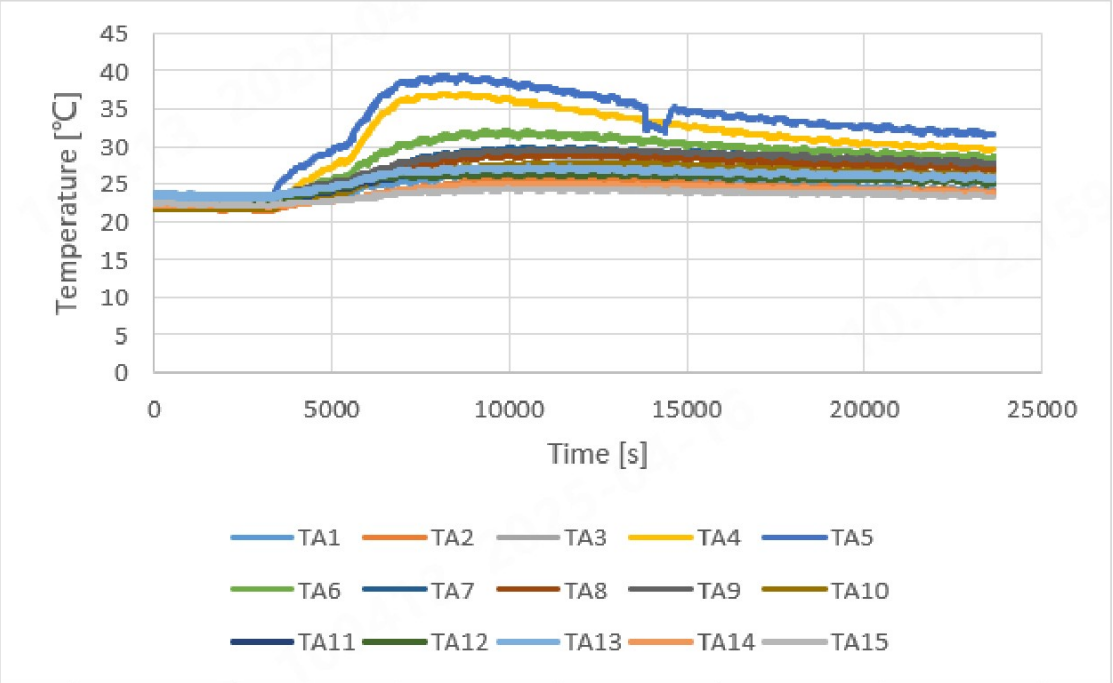
The detailed locations of the thermocouple arrays are shown in the below figure.



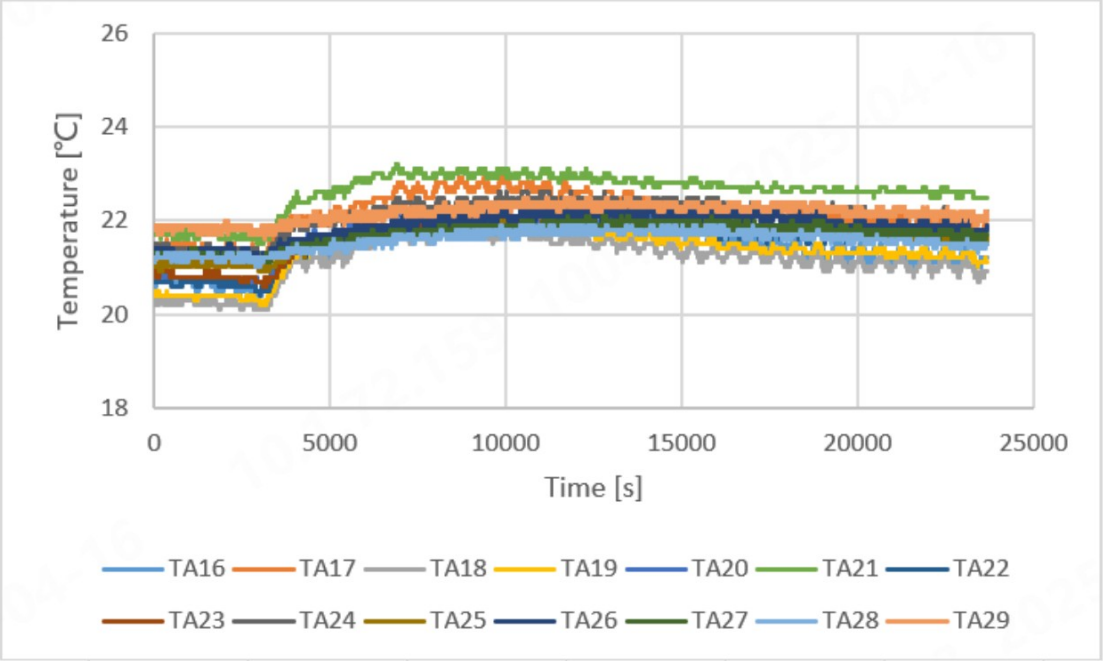
Thermocouple array location (view side: front view)

The first thermocouple starts from 152 mm from the ground. A total of 41 thermocouples were used for array A, array B and array C. The thermocouples were numbered from low to high as TA1 to TA15 for thermocouple array A, TA16 to TA29 for thermocouple array B, TA30 to TA41 for thermocouple array C.

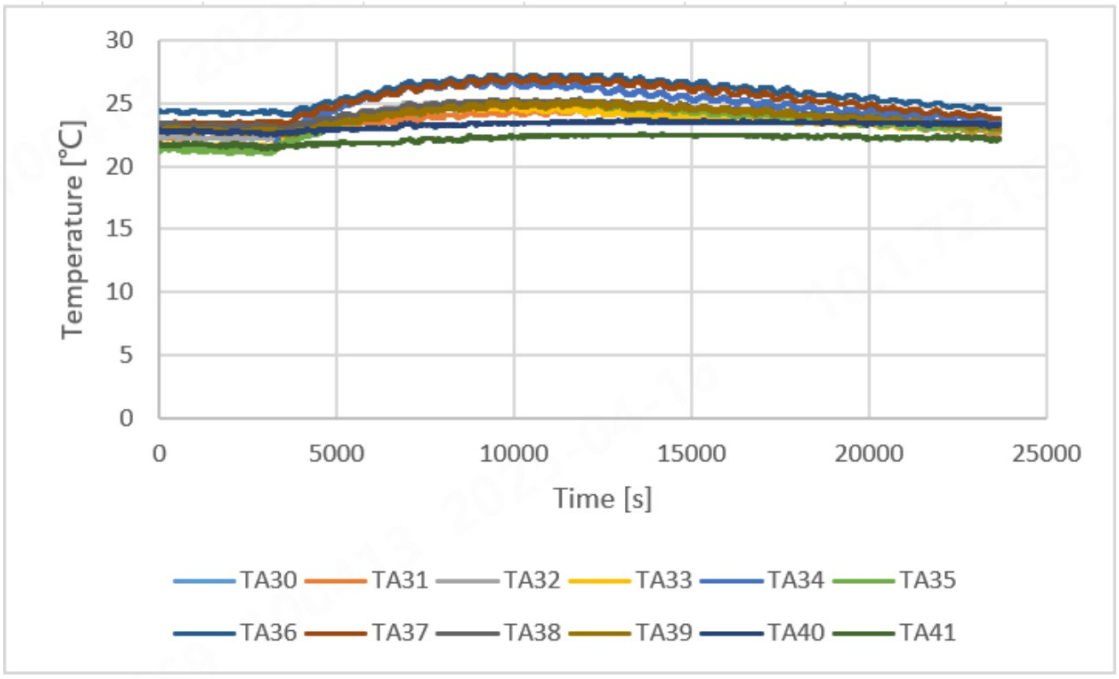
The measured surface temperature of instrumental wall A during test is shown in below figure.



The measured surface temperature of the left enclosure surface of target unit 1 during test is shown in below figure.



The measured surface temperature of the right enclosure surface of target unit 2 during test is shown in below figure.

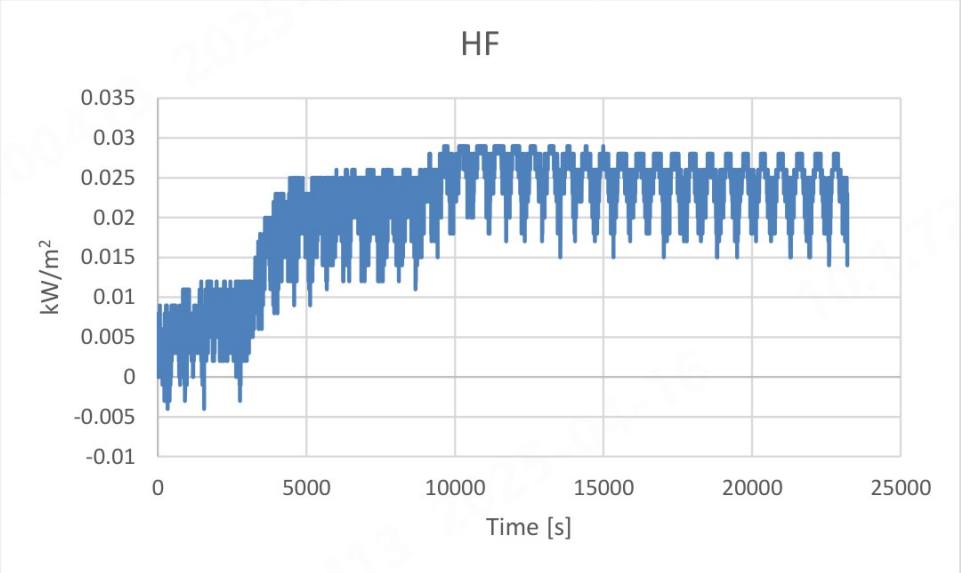


The maximum measured surface temperature of each location on the instrumental wall A, the left enclosure surface of target unit 1 and the right enclosure surface of target unit 2 is shown in the below table.

Thermocouple No.	Maximum temperature (°C)
Surface temperature on instrumental wall A	
TA1	26.8
TA2	25.8
TA3	28.9
TA4	37.0
TA5	39.5
TA6	32.0
TA7	29.9
TA8	29.0
TA9	29.6
TA10	27.8
TA11	27.2
TA12	26.6
TA13	27.4
TA14	25.1
TA15	24.5
Surface temperature on left enclosure surface of target unit 1	
TA16	22.2
TA17	22.9
TA18	21.9
TA19	22.1
TA20	22.3
TA21	23.2
TA22	22.1
TA23	22.1
TA24	22.6
TA25	22.0
TA26	22.3
TA27	22.1
TA28	21.9
TA29	22.5
Surface temperature on the right enclosure surface of target unit 2	
TA30	25.0
TA31	24.5
TA32	25.3
TA33	24.8
TA34	26.8
TA35	25.3
TA36	27.3
TA37	27.1
TA38	25.4
TA39	25.1
TA40	23.7
TA41	22.6

Attachment 7 Heat flux measurements

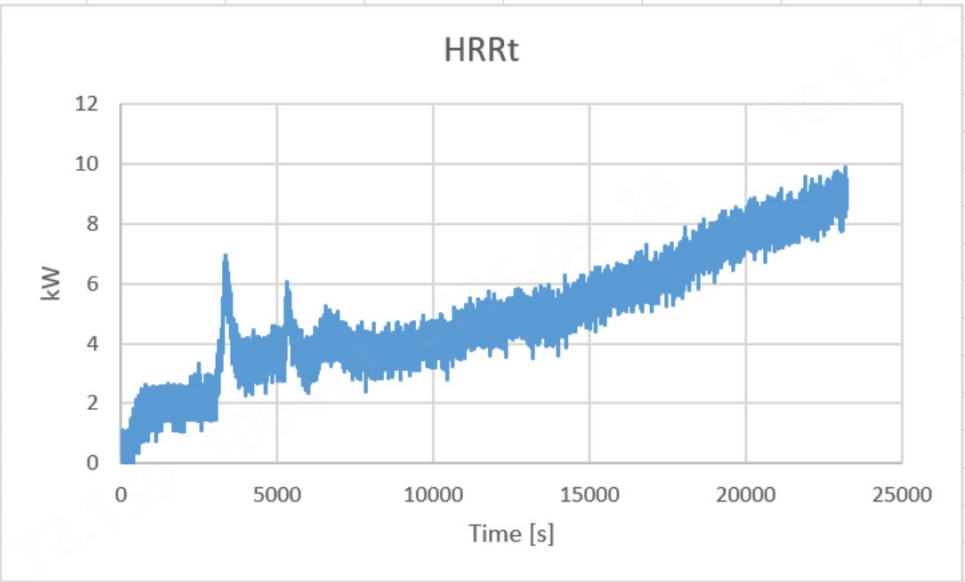
Measure Heat flux in the center of the accessible means of egress: 0.029KW/m²



Attachment 8 Chemical heat release rate measurement

The chemical heat release rate was measured by a measurement system consisting of a paramagnetic oxygen analyzer, non-dispersive infrared carbon dioxide and carbon monoxide analyzer, velocity probe, and a Type K thermocouple. The instrumentation was located in the exhaust duct of the heat release rate calorimeter at a location that minimizes the influence of bends or exhaust devices.

Measured peak chemical heat release rate HRRt: 9.88kW.



Chemical heat release rate (HRRt) versus time data curve

Attachment 9 Convective heat release rate measurement

The convective heat release rate was measured using thermopile, a velocity probe, and a Type K thermocouple, located in the exhaust system of the exhaust duct.

The convective heat release rate was calculated at each of the flows as follows:

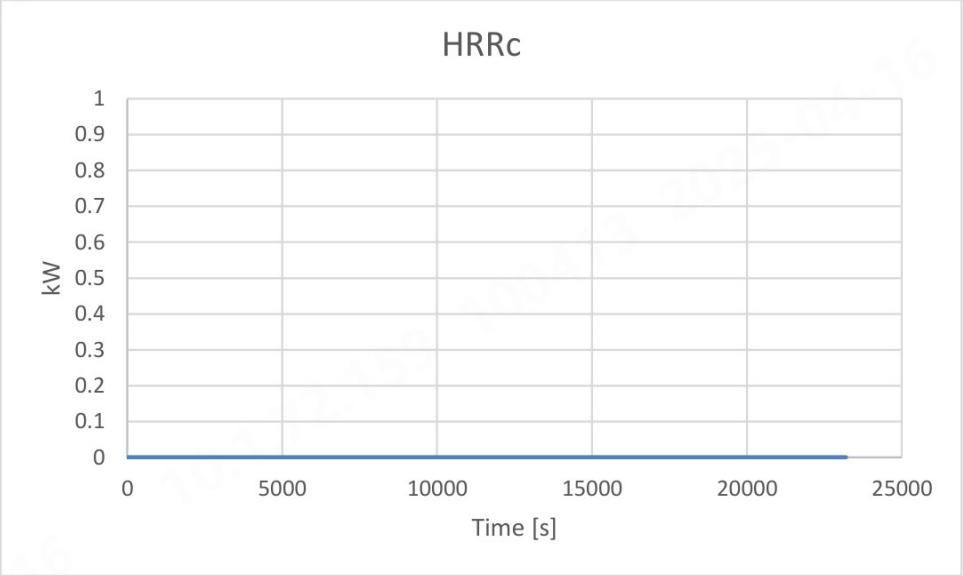
$$HRR_c = V_e A \frac{353.22}{T_e} \int_{T_o}^{T} C_p dT$$

Where:

HRR_c = The convective heat release rate (kW)
V_e = The exhaust velocity (m/s)
A = The exhaust duct cross sectional area (m^2)
T_e = The temperature at the location where exhaust velocity is measured (K)
$353.22/T_e$ = The density of air at the velocity measurement location (kg/m^3)
T_o = The ambient temperature (K) in the test room
T= The thermopile temperature (K)

$$\int_{T_o}^{T} C_p dT = A_0(T - T_o) + A_1/2(T^2 - T_o^2) + A_2/3(T^3 - T_o^3) + A_3/4(T^4 - T_o^4)$$

Cp = Specific heat of air (kJ/kg-K), given as *Cp = A0 + A1T + A2T2 + A3T3*, where:
A0 = 0.9950
A1 = -5.29933E-05
A2 = 3.21022E-07
A3 = -1.22004E-10
The measured peak convective heat release rate HRRc was 0 kW.



Convective heat release rate (HRRc) versus time data curve

Attachment 10 Gas generation measurement

Vent gas composition were measured using a Fourier-Transform Infrared Spectrometer with a resolution of 0.5 cm^{-1} and a path length of 5.11 m within the calorimeter's exhaust duct. And the composition, velocity and temperature of the vent gases were measured within the calorimeter's exhaust duct.

The hydrocarbon content of the vent gas was measured using flame ionization detection.
The Hydrogen content was measured with a palladium-nickel thin-film solid state sensor, a heat conduction sensor and an electrochemistry sensor.

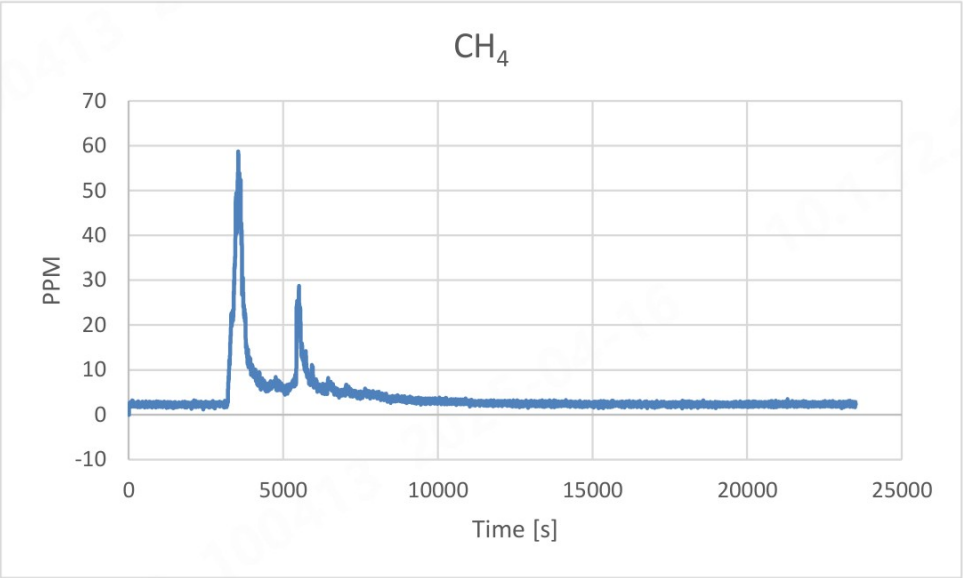
The Hydrogen was not detected by the palladium-nickel thin-film solid state sensor and heat conduction sensor. The Hydrogen content value in the below table was measured by electrochemistry sensor.

The gas composition and volume are shown in the below table.

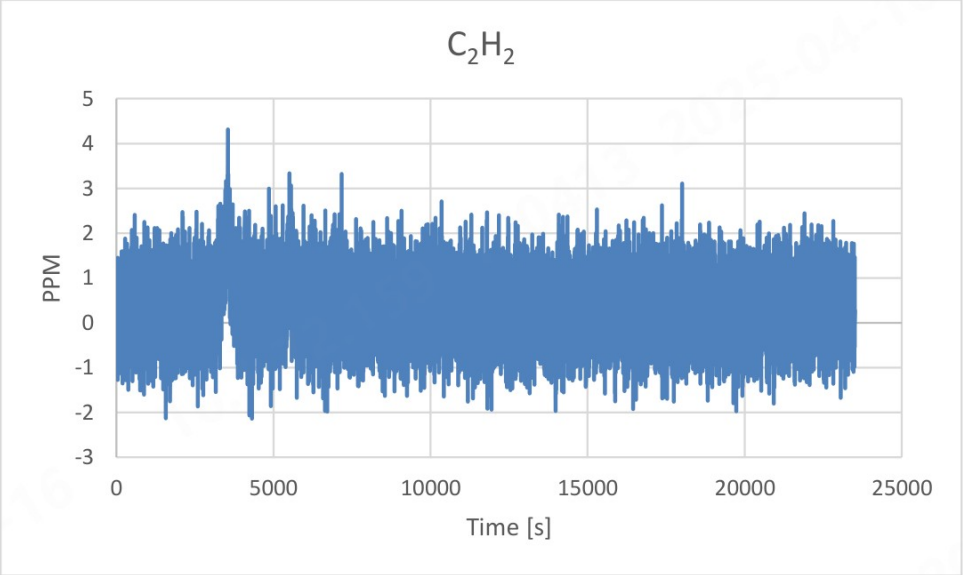
Gas type	Gas components		Total volume of gas (L)
Hydrocarbon species	Methane	CH_4	102.08
	Acetylene	C_2H_2	1.68
	Ethylene	C_2H_4	49.95
	Ethane	C_2H_6	6.07
	Propylene	C_3H_6	41.32
	Propane	C_3H_8	5.14
Hydrogen halide species	Hydrogen Fluoride	HF	6.27
Other species	Carbon Monoxide	CO	98.39
	Carbon Dioxide	CO_2	244.07
	Ethylmethyl carbonate	C_4H_8O	34.15
	Oil as octane	--	3.46
	Hydrogen	H_2	692.32
Total Hydrocarbons (equivalent to CH_4, measured by FID)			177.38

Concentration of different gas components according to gas species classification was displayed as following graphs.

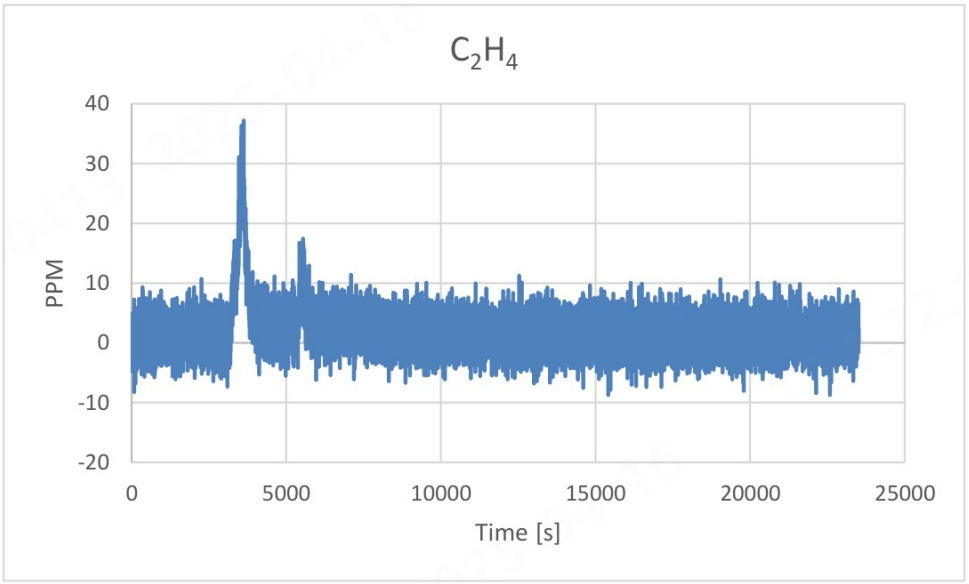
Hydrocarbon species



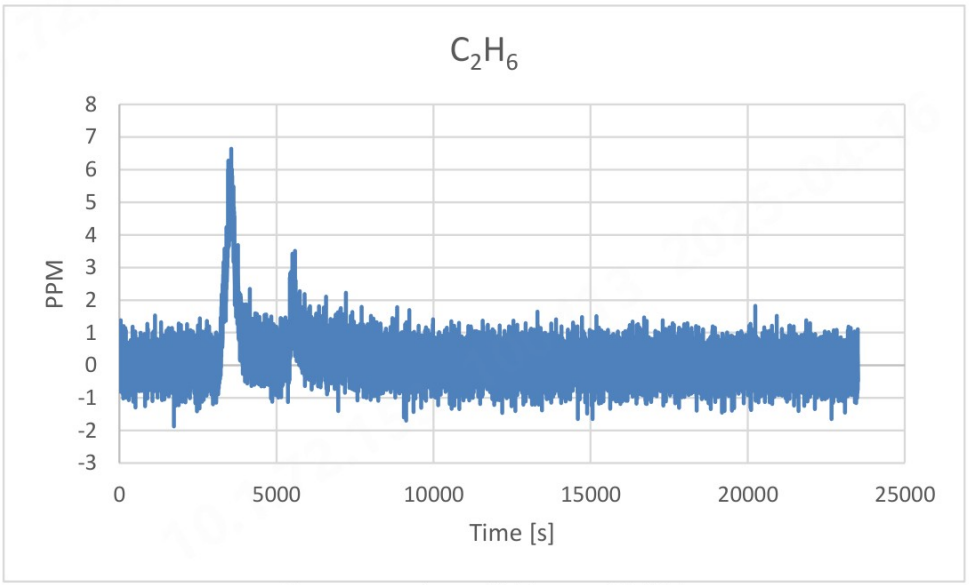
Concentration of Methane (CH_4)



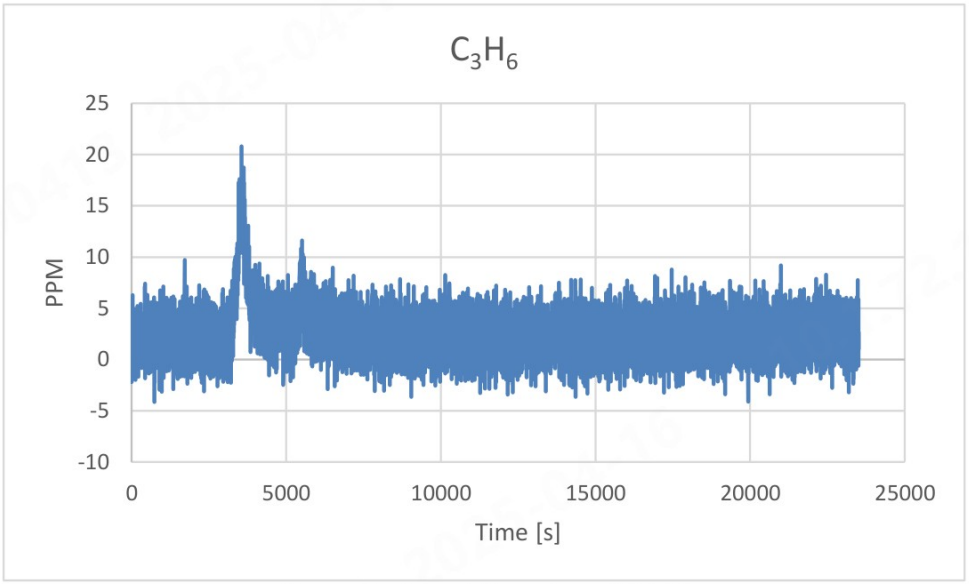
Concentration of Acetylene (C_2H_2)



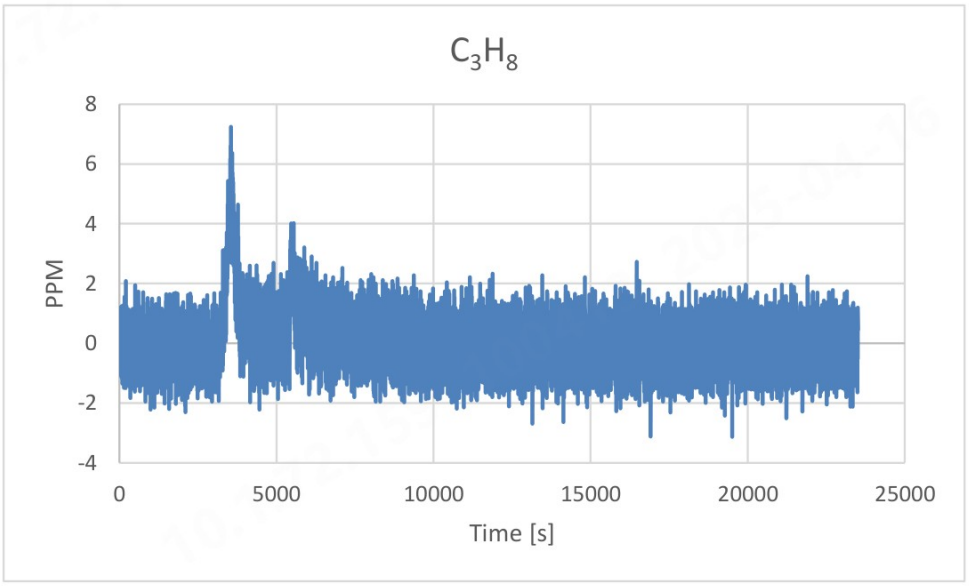
Concentration of Ethylene (C_2H_4)



Concentration of Ethane (C_2H_6)

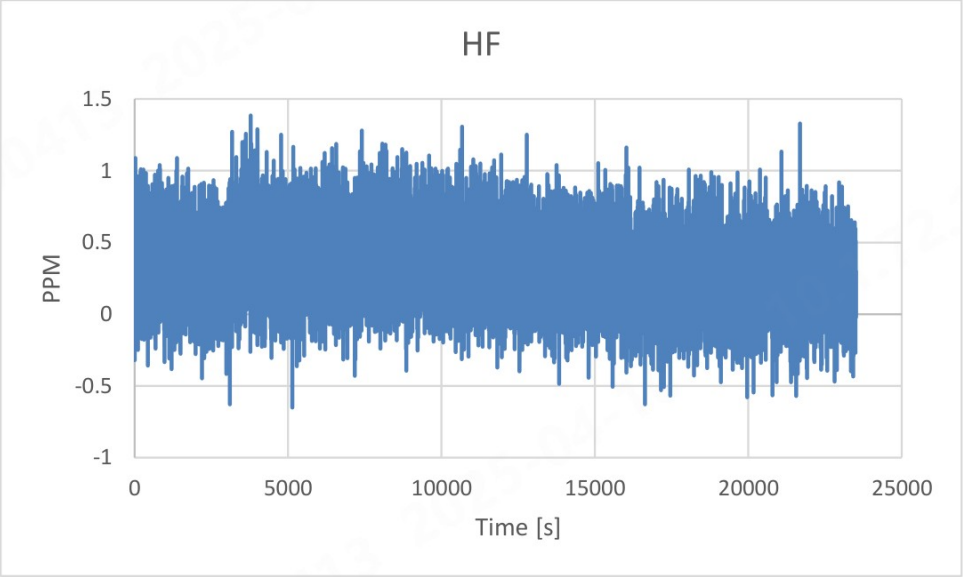


Concentration of Propylene (C_3H_6)



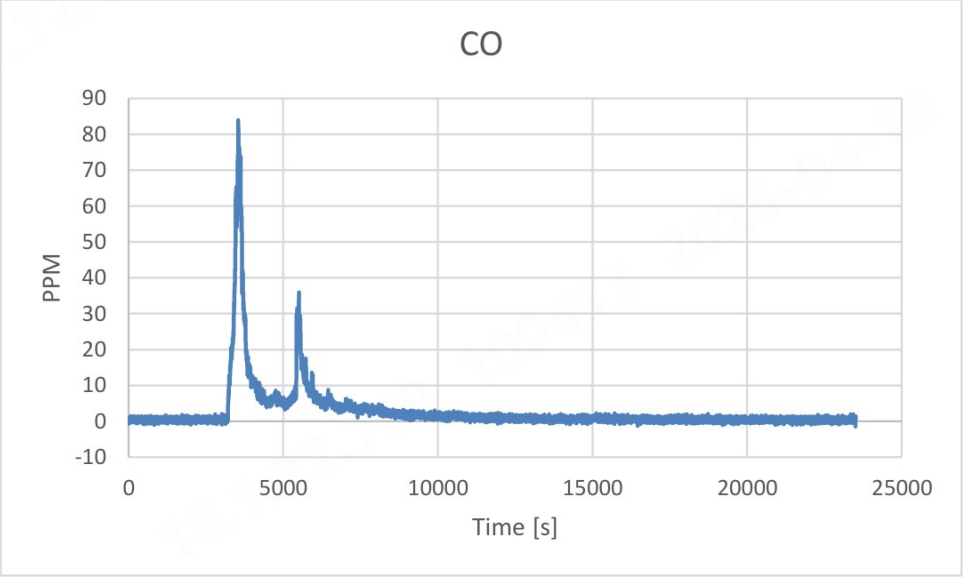
Concentration of Propane (C_3H_8)

Hydrogen halide species

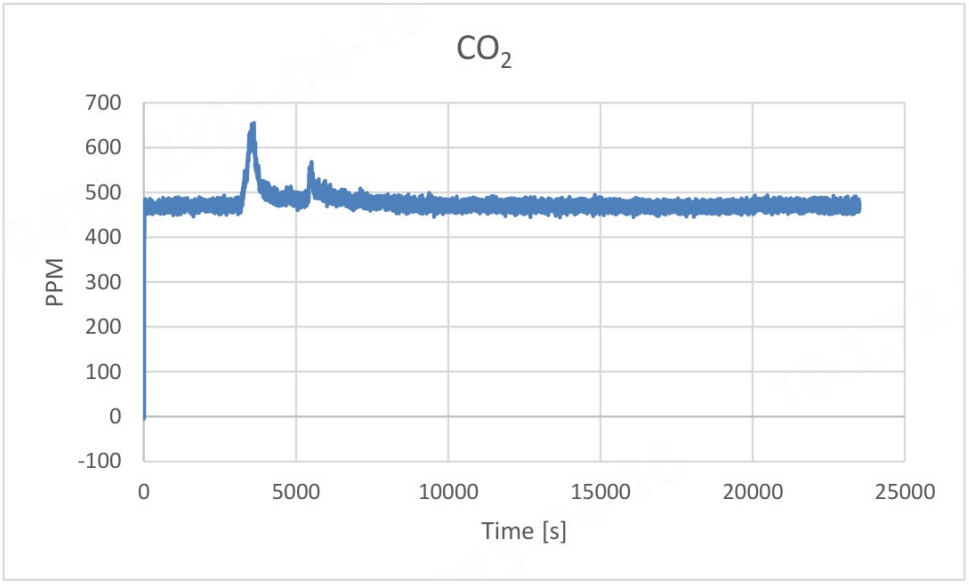


Concentration of Hydrogen Fluoride (HF)

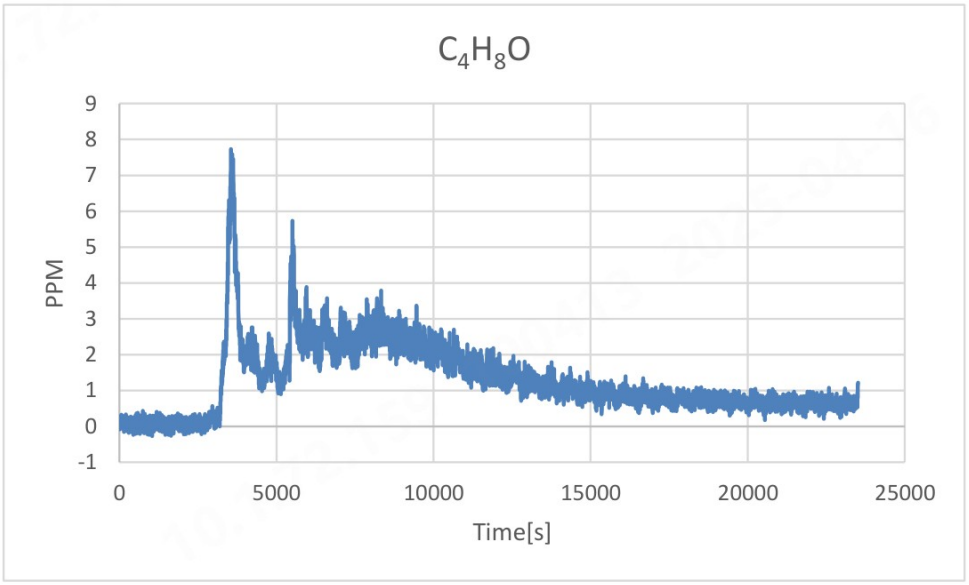
Other species



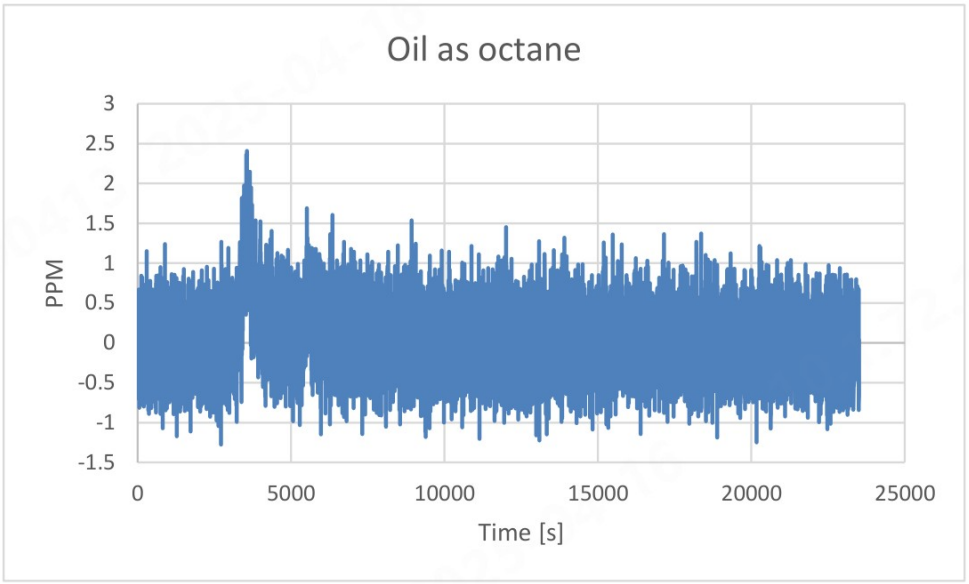
Concentration of Carbon Monoxide (CO)



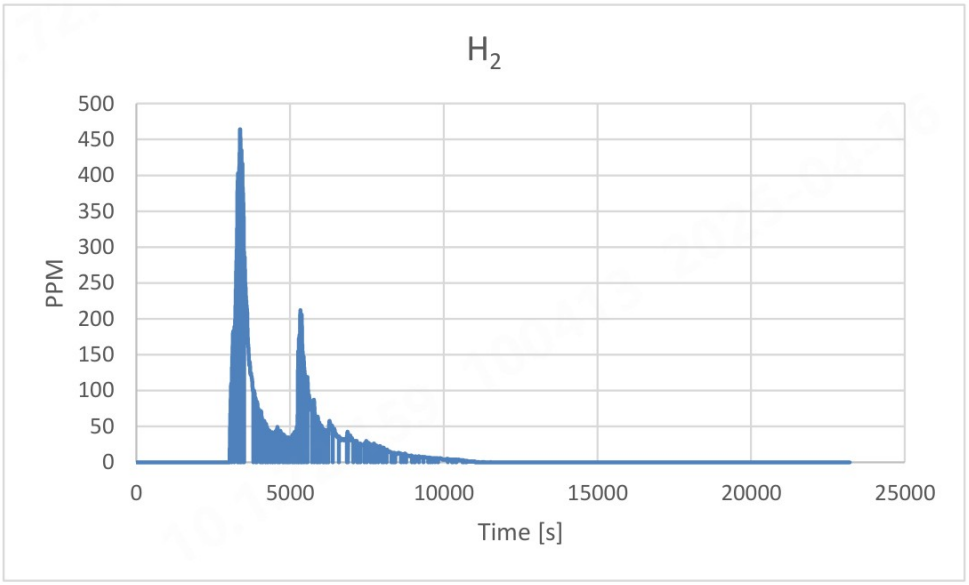
Concentration of Carbon Dioxide (CO_2)



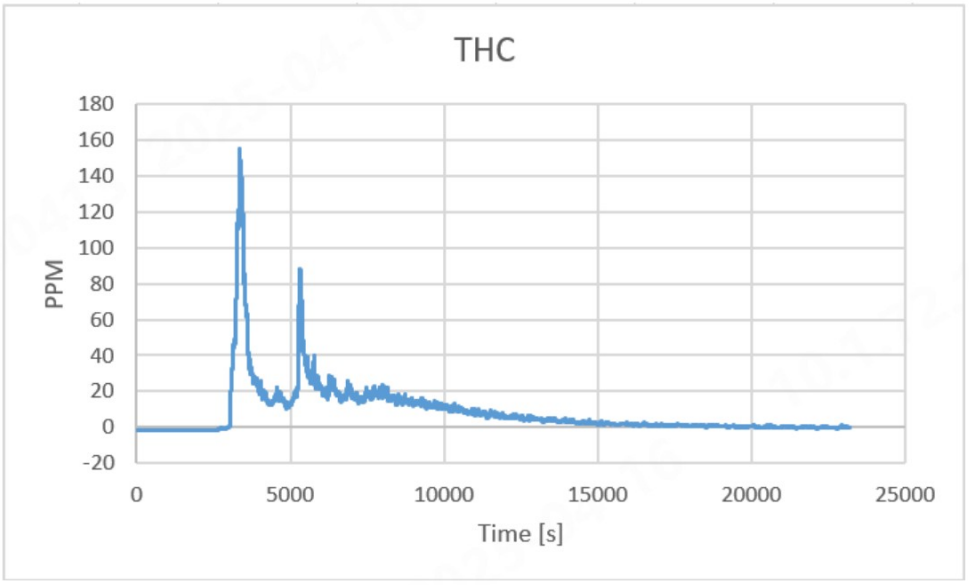
Concentration of Ethylmethyl carbonate(C_4H_8O)



Concentration of Oil as octane



Concentration of Hydrogen (H_2)
Electrochemical sensor



Concentration of total hydrocarbons (measured by FID)

Attachment 11 Smoke release rate measurement

Smoke release rate shall be calculated as follows:

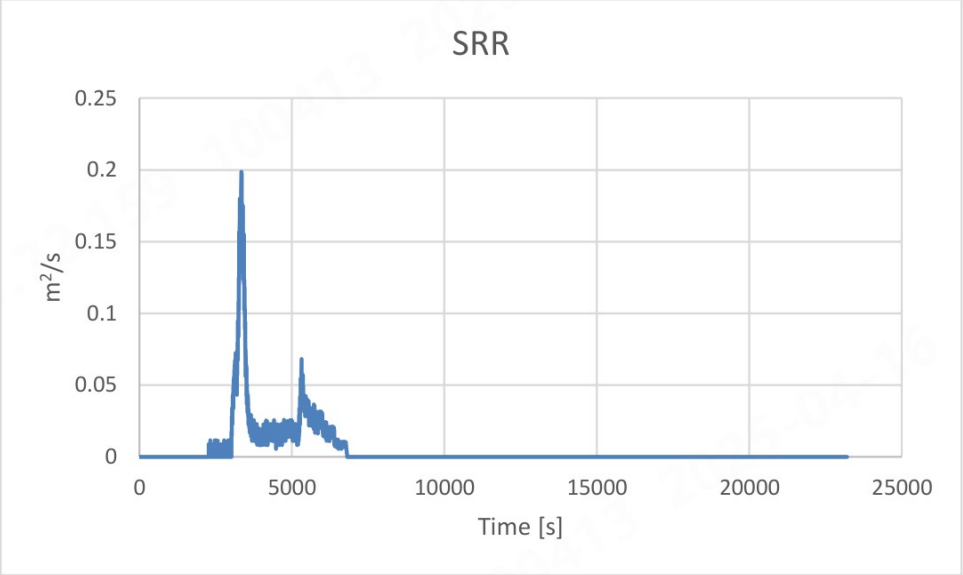
$$SRR = 2.303\left(\frac{V}{D}\right) Log_{10}\left(\frac{I_o}{I}\right)$$

Where:
SRR = Smoke release rate (m^2/s)
V = Volumetric exhaust duct flow rate (m^3/s)
D = duct diameter (m)
Io = Light transmission signal of clear (pre-test) beam (V)
I = Light transmission signal during test (V)

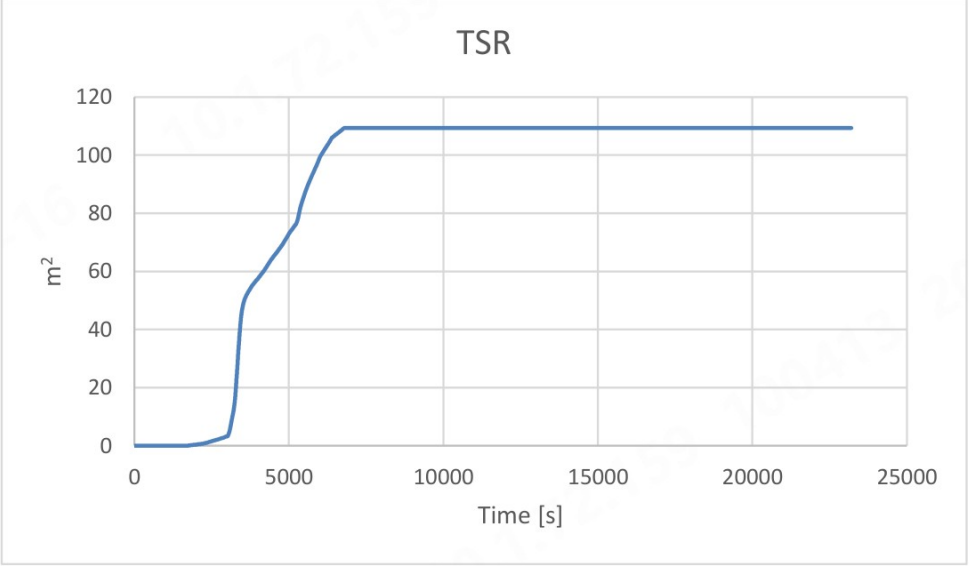
The smoke release rate measurement system was self-checked using calibrated light filter before test.

Measured peak smoke release rate SRR: 0.1987m^2/s
Measured total smoke release TSR: 109.4m^2

Smoke release rate (SRR) versus time data curve



Total smoke release (TSR) versus time data curve



Attachment 12 Equipment list

No.	Equipment	Model	Rating	Inventory no.	Initial cal. date
1	Ambient monitor	RS210	0%~ 100%RH, -20~70°C	SA047-106	2024-09-11
2	Digital multi-meter	175C	0~1000Vdc, 0~1000Vac	SA012-194	2024-07-24
3	Charge /discharge equipment	BAT-NE-250-V001	Max 900V, 400A	SA064-40	2024-07-23
4	3MW lithium battery heat release calorimeter	RHR	0-1100°C, 0~0.4Mpa	SA200-69	2024-09-27
5	Gas analyzer	ABB AO2020	O_2: 0-25%, CO_2: 0-10%, CO: 0-1%	SA200-69-01	2024-08-27
6	Gas mass flowmeter	HZ020-LK2-S-L-C13-R4-DI2-DB9M-050-500-101	0-500SLPM	SA200-69-02	2024-04-28
7	The total hydrocarbon gas analyzer	ABB EL3020	TCH: 0-10000ppm, CH_4: 0-10000ppm, C_3H_8: 0-3300ppm	SA200-70	2024-08-27
8	Palladium-nickel hydrogen analyzer	H2SCAN 710B	H2:0.1%-10%	SA200-71	2024-08-23
9	On-line Fourier infrared analyzer	MKS 6030	500cm^{-1}~4200cm^{-1}, 0.01ppm-100%	SA200-76	2025-01-07
10	Temperature and voltage acquisition device	79 channels	0-1100°C, 0-500V	SA200-73	2024-08-23
11	Electrochemical hydrogen analyzer	JKBS-J001-H2-Y05	0-1000ppm	SA200-74	2025-01-07
12	Electronic weighing scale	E310W	10~3000kg	SA028-59	2024-12-05

.....End of test report .....

PGS37 Noodplan — Batterijopslag

Locatie: H.W. Heinsiusweg 7, 1331 EH Almere

Contact klant / verantwoordelijke: [redacted] — [redacted]

Installatie:

Batterij type:	**LiFePO4**
Totaal opslagcapaciteit:	**504 kWh**
Opstelling:	**42 packs × 12 kWh per pack**
Omvormervermogen:	**242 kW**
System ingress protection rating:	**IP66 geclassificeerd.**

Notitie:

Actieve blusmodules per pack aanwezig.

Batterij geplaatst achter brandwerende wand

Datum document: 13 oktober 2025

Ondertekend:

Inhoud

1 Doel en reikwijdte

Dit document beschrijft het PGS37-conforme noodplan voor de batterijopslaginstallatie op:

Termeulen Roses, H.W. Heinsiusweg 7, 1331 EH Almere

Doel:

- schade aan personen en omgeving te voorkomen of te beperken

- brand- en incidentprocedures vast te leggen

- rollen en verantwoordelijkheden te definiëren

- communicatie- en alarmeringslijnen te regelen

- de brandweer en hulpdiensten heldere informatie te bieden.

Reikwijdte:

Alle gebeurtenissen met betrekking tot de batterijopslag (thermische runaway, rookontwikkeling, lekkage, waterinfiltratie, mechanische schade.)

2 Samenvatting installatie & relevante testgegevens

- Type batterij: **LiFePO4**.
- Opslag: **504 kWh** (42 × 12 kWh packs).
- Omvormers: **250 kW**.
- Beschermingsgraad packs/systemen: **IP66** (water-/stofbestendig).
- Blusvoorziening: **Actieve blusmodules per pack**

Belangrijke resultaten uit UL9540A-tests

- Geen externe vlamvorming of explosieve gebeurtenissen geobserveerd.

- Geen vonken of vliegend puin tijdens incident.

- Gewichtsverlies van een geteste module: ~7% (8,5 kg op 122,5 kg).

- Temperatuur buitenzijde module bleef onder **250°C**.

- Heat Release Rate (HRR): **19,11 kW**.

- Smoke Release Rate (SRR): **9,291 m^2/s** (TSR: **2.286 m^2**).

3 Risicoanalyse (korte weergave)

Een risicobeoordeling is uitgevoerd voor de installatie en opslag van lithiumijzerfosfaat ($LiFePO_4$) energiedragers. De onderstaande risico's zijn geïdentificeerd als potentieel relevant voor de veiligheid van mens, milieu en installatie. Deze beoordeling betreft een samenvatting

3.1 Geïdentificeerde risico's

a. Thermische runaway per batterijpack

- Oorzaak: Interne cel- of packstoring (bijv. productiefout, oververhitting) of externe beschadiging (bijv. mechanische impact, blootstelling aan vuur).
- Effect: Snel toenemende temperatuur, gasvorming en mogelijk brand of explosie.
- Maatregelen: Temperatuurmonitoring, BMS (Battery Management System), mechanische bescherming per pack.

b. Rookontwikkeling en vrijkomen van giftige stoffen

- Oorzaak: Oververhitting of brand leidt tot thermische ontleding van celcomponenten.
- Effect: Rook bevat potentieel irriterende of schadelijke stoffen, ondanks relatief lage gasvorming bij $LiFePO_4$ in vergelijking met andere lithium-ion chemieën.
- Maatregelen: Rookdetectie, adequate ventilatie, PBM's voor hulpdiensten, instructie voor personeel.

c. Elektrische risico's

- Oorzaak: Hoge gelijkstroom- en wisselstroomspanningen (DC/AC), met risico op kortsluiting, elektrocutie of vlamboog.
- Effect: Letsel, brand, schade aan apparatuur.
- Maatregelen: Afschermingen, spanningsvrije zones, lock-out/tag-out procedures, voorlichting.

d. Water en milieu-impact

- Oorzaak: Waterinbraak of gebruik van bluswater bij incident.

- Effect: Mogelijke verontreiniging van waterstromen met chemische residuen of metalen; storing van elektrische systemen.
- Maatregelen: Installatie conform IP66; opvang en beheersing van bluswater, lekdetectie, milieu-instructie in calamiteitenplan.

e. Persoonlijke veiligheid

- Oorzaak: Directe blootstelling aan vuur, hitte, rook of spanning voerende delen.
- Effect: Brandwonden, rookinhalatie, elektrische schok of andere lichamelijke schade.
- Maatregelen: Training van personeel, beschikbaarheid van PBM's, duidelijke signalering en noodprocedures.

3.2 Risiconiveau en beheersbaarheid

Op basis van de uitgevoerde analyse is het **algemene risiconiveau als beheersbaar** geclassificeerd, mits voldaan wordt aan de volgende voorwaarden:

- Correcte installatie en onderhoud van technische beveiligingen (zoals BMS, afschermingen, blussystemen);
- Beschikbaarheid en naleving van standaard operationele procedures (SOP's);
- Regelmatige training en oefening van betrokken medewerkers en hulpdiensten.

3.3 Risico-Inventarisatie en -Evaluatie (RIE).

Deze RIE bevat de volgende kolommen:

- **Risico** – Omschrijving van het gevaar.
- **Oorzaak** – Directe bron of aanleiding van het risico.
- **Effect** – Wat is het mogelijk gevolg?
- **Kans** – Waarschijnlijkheid dat het zich voordoet (Laag/Middel/Hoog).
- **Impact** – Ernst van het gevolg (Laag/Middel/Hoog).

- **Risiconiveau** – Combinatie van kans × impact.
- **Beheersmaatregelen** – Reeds genomen of geplande maatregelen om risico's te beheersen.

Nr	Risico	Oorzaak	Effect	Kans	Impact	Risiconiveau	Beheersmaatregelen
1	Thermische runaway	Interne storing of externe beschadiging	Brand, rook, explosie	Laag	Hoog	**Hoog**	BMS, temperatuurmonitoring, mechanische bescherming, thermische scheiding
2	Rookontwikkeling & giftige stoffen	Ontleding celmateriaal bij hitte of brand	Irritatie, ademhalingsschade, toxische blootstelling	Middel	Middel	**Middel**	Rookdetectie, ventilatie, PBM's, evacuatieprocedures
3	Elektrische risico's	Blootstelling aan hoge spanningen (DC/AC)	Elektrocutie, vlamboog, kortsluiting	Laag	Hoog	**Middel**	Afscherming, lock -out/tag -out, instructie en signalering
4	Water/milieuverontreiniging	Inwatering of lozing van bluswater	Milieuschade, systeemuitval	Laag	Middel	**Laag**	IP66 behuizing, bluswateropvang, lekdetectie, milieuplan
5	Persoonlijke veiligheid	Hitte, rook, elektrische componenten	Brandwonden, ademhalingsproblemen, schokken	Middel	Middel	**Middel**	PBM's, training, signalering, veiligheidsprocedures

3.4 Toelichting op risiconiveaus

- **Laag**: Aanvaardbaar risico, geen aanvullende maatregelen noodzakelijk.
- **Middel**: Maatregelen noodzakelijk voor risicobeheersing; actief bewaken.
- **Hoog**: Directe beheersmaatregelen vereist; risico moet gemitigeerd worden vóór of tijdens ingebruikname.

4 Organisatie en verantwoordelijkheden

Voor een veilige opslag en verwerking van lithium-houdende energiedragers dient de organisatie duidelijke verantwoordelijkheden en taken vast te leggen. Onderstaande functionarissen zijn geïdentificeerd binnen de organisatie en vervullen de volgende rollen:

4.1 Eigenaar

Naam: [redacted]

Functie: Eigenaar van de installatie

De eigenaar is eindverantwoordelijk voor de veilige bedrijfsvoering van het systeem en draagt zorg voor de volgende taken:

- Fungeren als primair aanspreekpunt voor hulpdiensten in geval van een incident of calamiteit;
- Zorgdragen voor het opstellen, actualiseren en archiveren van onderhouds- en inspectierapporten van de installatie;
- Organiseren en faciliteren van on-site instructies, veiligheidsrondgangen en (ontruimings)oefeningen voor personeel en bezoekers.

4.2 Technisch contact

Functie: Aangewezen technisch personeel

Contactinformatie: [opnemen vervangend contactnummer in bedrijfsadministratie]

De systeembeheerder is verantwoordelijk voor het technisch beheer van de installatie. Tot de taken behoren onder meer:

- Fungeren als secundair aanspreekpunt voor hulpdiensten, indien de eigenaar/operator niet bereikbaar is;
- Coördinatie van technische maatregelen bij afwijkingen of storingen;
- Rapporteren van technische gebreken aan de eigenaar/operator.

4.3 Taken bij incidenten

Bij een incident met (mogelijke) impact op de veiligheid, zijn onderstaande handelingen van toepassing. De uitvoering ervan gebeurt conform opgestelde procedures en enkel indien veilig uitvoerbaar:

- **Directe alarmering** van externe hulpdiensten en interne stakeholders;
- **Isoleren van het systeem** en uitvoeren van een veilige uitschakeling (safe shutdown);
- Indien noodzakelijk, **initiëren van een ontruiming** en coördineren van de gang naar het aangewezen verzamelpunt (samenkomstlocatie).

4.4 Vervangingsregeling en beschikbaarheid

Er wordt gezorgd voor een actuele vervangingsregeling voor de sleutelfuncties. Contactgegevens van vervangend personeel worden opgenomen in de bedrijfsadministratie en zijn 24/7 beschikbaar voor interne en externe meldingen.

5 Alarmering & communicatie

Een effectieve en snelle communicatie bij incidenten is essentieel voor het beperken van schade, het beschermen van personen en het faciliteren van hulpverlening. In deze paragraaf zijn de procedures voor alarmering en de benodigde contactinformatie opgenomen.

5.1 Noodnummers en contactpersonen

Doel	**Nummer / Contactpersoon**
Brandweer / Ambulance / Politie	112 (alleen bij noodsituaties)
Primair intern contact	[redacted] — [redacted]

5.2 Interne alarmeringsprocedure

Bij een (vermoedelijk) incident zoals brand, rookontwikkeling, explosie of kortsluiting, dient de volgende alarmeringsprocedure gevolgd te worden:

1. Bel onmiddellijk 112 bij constatering van brand, rookontwikkeling, explosie of bij twijfel over de veiligheidssituatie.
2. Informeer direct de eigenaar:
   [redacted] – [redacted].
3. Activeer de interne alarmsystemen, waaronder (indien van toepassing):
   - Akoestische en/of visuele signalering (sirene / lichtsignaal);
   - Interne PA-installatie (omroep);
   - SMS-, app- of e-mailnotificaties aan interne responsegroepen;
   - Start ontruimingsprocedure conform evacuatieplan.

5.3 Te verstrekken informatie aan hulpdiensten

Bij melding aan de meldkamer (112) en bij aankomst van de hulpdiensten, dient de volgende informatie paraat te zijn:

- Locatie incident:
  H.W. Heinsiusweg 7, 1321 AA Almere
- Type installatie:
  Stationaire batterijopslag – $LiFePO_4$ technologie
- Energie-inhoud:
  Totaal 504 kWh (42 packs × 12 kWh)
- Omvormervermogen:
  250 kW (AC-zijde)
- Behuizing en bescherming:
  IP66 geclassificeerde behuizing met actieve blusmodules per pack
- Contactpersoon op locatie:
  [redacted] – [redacted]

5.4 Instructie voor hulpdiensten

Adviseer de meldkamer of de eenheden ter plaatse bij melding of aankomst:

- Contacteer vooraf de locatieverantwoordelijke via het mobiele nummer van [redacted], zodat:
  - Toegang tot het terrein tijdig kan worden verleend;
  - Technische documentatie (zoals installatieoverzicht, MSDS, plattegronden) klaar kan liggen;
  - Informatie over isolatiepunten, noodstroom en veilige benadering beschikbaar is.

5.5 Communicatiemiddelen

- Mobiele telefoon: voor directe communicatie met hulpdiensten en personeel;
- Alarmeringssysteem (optioneel): afhankelijk van de bedrijfsspecifieke installatie (sirene, SMS, omroep);
- Informatiepanelen: noodprocedures opgehangen bij ingang, technische ruimte en opslaglocatie.

6 Ontruiming en afbakening

6.1 Doel en Toepassingsgebied

Dit hoofdstuk beschrijft de procedures voor ontruiming van personeel en de afbakening van het incidentgebied bij een calamiteit met de energieopslaginstallatie (batterijopslag). De richtlijnen zijn opgesteld conform PGS 37 en zijn van toepassing op alle aanwezige medewerkers, bezoekers en hulpdiensten tijdens een incident.

6.2 Ontruimingsregels

1. Algemene instructie

Bij het afgaan van een alarm, rookontwikkeling, brand of een ander incident in of nabij de installatie:

- Verlaat onmiddellijk het terrein via de aangewezen vluchtroutes.
- Begeleid bezoekers en derden naar het verzamelpunt.
- Sluit waar mogelijk deuren en poorten achter u om verdere verspreiding van rook of vuur te beperken.

2. Verzamelpunt

Alle personen begeven zich direct naar het aangewezen verzamelpunt. Het verzamelpunt moet:

- Visueel zijn aangeduid op het terrein (met bord of markering);
- Op een veilige afstand van de installatie liggen:
  - Minimaal 100 meter bij duidelijk waarneembare brand of rook;
  - Grotere afstand (>100 m) bij ernstige rookontwikkeling, explosiegevaar of branduitbreiding.

De bedrijfshulpverlening (BHV) controleert de aanwezigheid van alle medewerkers en bezoekers aan de hand van de aanwezigheidsregistratie.

3. Toegang en toezicht

Onbevoegde personen mogen niet in de nabijheid van de installatie blijven. De BHV of veiligheidscoördinator waarborgt dat de toegang tot het afgezette gebied wordt beperkt tot bevoegde personen en hulpdiensten.

6.3 Afzetgebied en Veiligheidszones

1. Eerste afzetting (Veiligheidszone 1)

Direct na een incident wordt een primaire veiligheidszone ingesteld van 30–50 meter rond de batterijcontainer/installatie. Alleen bevoegd personeel en hulpdiensten hebben toegang tot deze zone. De afzetting wordt duidelijk aangeduid met linten, hekken of andere fysieke markeringen.

2. Uitbreiding van de afzetting (Veiligheidszone 2)

Bij rookontwikkeling, brand, gasvorming of instabiele condities wordt het afzetgebied uitgebreid tot minimaal 100 meter rondom de installatie. Indien noodzakelijk kan de brandweer of veiligheidsadviseur besluiten de afstand verder te vergroten op basis van:

- Windsnelheid en -richting;
- Rook- en gasverspreiding;
- Werkelijke omvang van het incident.

3. Beoordeling door de brandweer

De brandweer bepaalt de definitieve grenzen van het afzetgebied en veiligheidszone conform actuele situatie en risico-inschatting. De brandweer kan aanvullende maatregelen opleggen, zoals evacuatie van aangrenzende gebouwen of tijdelijke wegafzettingen.

6.4 Herbezetting en Veiligverklaring

Terugkeer naar het terrein of de installatie is uitsluitend toegestaan na vrijgave door de brandweer of de verantwoordelijke veiligheidscoördinator. De vrijgave wordt pas verleend nadat de situatie volledig onder controle is en er geen risico's meer zijn voor gezondheid, veiligheid of milieu.

6.5 Verantwoordelijkheden

Rol / Functie	Verantwoordelijkheden
BHV-coördinator	Start ontruiming, controleert aanwezigheid en communiceert met hulpdiensten
Beveiliging / Toegangspoort	Sluit toegang voor onbevoegden, helpt bij afzetting
Veiligheidskundige / Operationeel verantwoordelijke	Adviseert over risicoafstanden, ondersteunt brandweer
Brandweer	Beheerst incident, stelt veiligheidszones vast en bepaalt vrijgave

Directe incidentprocedures (stappenplan)

Dit hoofdstuk beschrijft de directe te nemen stappen bij detectie van rook, brand of abnormale warmte in of nabij de energieopslaginstallatie (batterijopslag). De procedure is bedoeld om snel en veilig te handelen totdat professionele hulpdiensten de situatie overnemen.

7.1 Stappenplan bij incident

1. Activeer het alarm en bel 112. Meld de exacte locatie en het type installatie.

2. Waarschuw [redacted] en het technisch personeel.

3. Indien veilig en door getraind personeel mogelijk: activeer de automatische of handmatige blusmodules conform de fabrikant-procedures. Start geen handmatige interventies in de nabijheid van hoge spanningen zonder toepassing van isolatieprocedures.

4. Schakel indien mogelijk de DC/AC-koppelingen uit ('safe shutdown') via het besturingssysteem — alleen door getraind personeel en indien dit veilig kan.

5. Evacueer onmiddellijk het gebouw en terrein conform het ontruimingsplan.

6. Houd afstand en laat de professionele brandweer het incident volledig overnemen.

7.2 Wanneer niet zelf blussen

Bij een incident mag alleen door getraind personeel worden geblust, en uitsluitend als dit zonder risico mogelijk is. In de volgende situaties wordt niet geblust en wordt direct geëvacueerd:

- Bij grote rookontwikkeling, open vlammen of onduidelijke risico's.
- Indien de herkomst van de rook of warmte niet met zekerheid kan worden vastgesteld.
- Wanneer brand zich verspreidt naar aangrenzende installaties of gebouwen.

Tijdens en na het incident moet contact met besmet bluswater en afgevallen batterijmateriaal worden vermeden. Gebruik persoonlijke beschermingsmiddelen (PBM) indien noodzakelijk.

7.3 Verantwoordelijkheden

Rol / Functie	Taken tijdens incident
Eerste melder	Activeert alarm, belt 112 en meldt locatie en type installatie.
Technisch personeel	Ondersteunt bij veilige uitschakeling en toepassing isolatieprocedures.
[redacted]	Wordt onmiddellijk geïnformeerd en coördineert de interne noodrespons.
BHV / Veiligheidscoördinator	Begeleidt ontruiming en voorkomt toegang van onbevoegden.
Brandweer	Neemt incidentbestrijding volledig over bij aankomst.

8 Richtlijnen voor brandweer en hulpdiensten (technische informatie)

- **Chemie:** LiFePO4 (minder kans op zuurstof-gestuurde runaway dan sommige NMC/NCA types), maar nog steeds energetisch.
- **Elektrisch risico:** behandel alle onderdelen als onder spanning; grote DC-kabels aanwezig. Gebruik geïsoleerd gereedschap en geschikte PBM.
- **Blusmiddel:** water (grote volumes) is toegestaan voor koeling en beheersing van hitte; overweeg blussing van omliggende branden en koeling van packs om herontsteking te voorkomen. Gebruik brandweerslang met grote doorstroom en koelingsstrategieën.
- **Spreiding van bluswater:** houd rekening met afvoer en milieu-contaminatie; opvang / afsluitingen realiseren waar mogelijk.
- **Automatische blusmodules:** informeer brandweer over de aanwezigheid en werking (locatie, activeringswijze). Indien mogelijk: laat automatische modules hun werk doen en ondersteun met koeling vanaf veilige afstand.
- **Risico op vliegend puin / explosieve gebeurtenissen:** UL9540A rapporteert géén explosieve gebeurtenissen of vliegend puin bij testen — desondanks moet rekening gehouden worden met onvoorspelbaarheid op installatieniveau.

9. Persoonlijke Beschermingsmiddelen (PBM)

Bij incidenten met energieopslaginstallaties gelden verhoogde risico's door mogelijke rook, gassen, hitte en elektrische spanning. Het dragen van de juiste persoonlijke beschermingsmiddelen (PBM) is verplicht voor iedereen die werkzaamheden uitvoert binnen het afgezette gebied.

Volledig ademluchttoestel (SCBA) bij aanwezigheid van rook en onbekende gassen.

Brandwerende kleding, isolerende handschoenen en veiligheidslaarzen.

Geïsoleerd gereedschap voor elektrische werkzaamheden.

10. Omgevings- en Milieumaatregelen

Incidenten met batterijopslag kunnen leiden tot emissies van gevaarlijke stoffen of verontreiniging van water en bodem. Ter bescherming van de omgeving gelden de volgende maatregelen:

Voorkom dat bluswater onbeperkt in het grondwater of de riolering terechtkomt; gebruik waar mogelijk opvangvoorzieningen of bermen.

Verzamel incidentafval (zoals beschadigde batterijpacks of vervuild koelwater) afzonderlijk conform afvalregelgeving.

Laat afval analyseren en verwerken door een erkende afvalverwerker met ervaring in batterijafval.

11. Nazorg en Herstel

Na afloop van een incident wordt een volledige evaluatie en herstelprocedure uitgevoerd. Hiermee wordt de veiligheid van de installatie en het terrein hersteld en worden verbeterpunten vastgelegd.

Laat het incident onderzoeken door het technisch team en, indien nodig, door een externe deskundige.

Verwijder en vervang beschadigde batterijpacks conform voorschriften van de fabrikant en geldende wetgeving.

Documenteer het incident, de genomen maatregelen en de 'lessons learned'.

Voer herstelwerkzaamheden uitsluitend uit na vrijgave door de verantwoordelijke persoon en/of brandweer.

12 Oefeningen, training en onderhoud

- Jaarlijks minimaal één volledige ontruimingsoefening met betrokken personeel en (indien mogelijk) lokale brandweer.
- Technische training over safe shutdown, gebruik van blusmodules en eerste respons minstens twee keer per jaar.
- Periodieke inspectie van packs, blussystemen en IP66 afdichtingen volgens fabrieksspecificaties.

13 Voorzieningen en materialen op locatie

- Officiële documentatie & databladen (MSDS / Safety Data Sheets) van de batterijen en blussystemen fysiek beschikbaar en digitaal.
- Schema's met layout van packs, schakelaars, DC-kabels en hoofdafschakeling.
- Beschermende barrières en bewegwijzering.
- Opleidingsregister en logboek van onderhoud en tests.

14 Checklists (snel)

Bij melding:

- [ ] Bel 112 en meld locatie + type installatie.

- [ ] Bel [redacted] ([redacted]).

- [ ] Activeer ontruiming en verzamelpunt.

Voor brandweer bij aankomst:

- [ ] Vraag naar UL9540A-rapporten (241016030GZU-001 / -002) en systeemdocumentatie.

- [ ] Informeer naar aanwezigheid en status van actieve blusmodules.

- [ ] Monitor rook, windrichting en afzetzones; bepaal veilige afstand.

15 Bijlagen

- A. Lay-out tekening batterijbank (aan te leveren door installer)
- B. Fabrikantprocedures voor Safe Shutdown en blusmodules
- C. Contactlijst (112; [redacted] technisch team; leverancier blussystemen)

Opmerkingen / Aanbevelingen

- Houd dit noodplan actueel en koppel wijzigingen in installatie (andere chemie, extra packs, wijziging blussysteem) direct terug in dit document.
- Zorg dat de brandweer één set van de relevante technische documenten digitaal en/of fysiek ontvangt.