Appendix N Hazardous Substances Assessment

Fast Track Approvals Act Application

Foxton Solar Farm

Genesis Energy Limited

SLR Project No.: 810.V14848.00001

13 February 2026

SLR

Technical Memorandum

Company:	Genesis Energy Limited	**From:**	SLR Consulting New Zealand
		Date:	10 December 2025
		Project No.	810.V14848.00001

RE: Hazardous Substances District Plan Regulatory Assessment
Foxton Solar Farm
Fast Track Approvals Act Application

As an expert witness I have read, and am familiar with, the Code of Conduct for expert witnesses contained in the Environment Court Practice Note 2023. This report has been prepared in compliance with that Code. In particular, unless I state otherwise, this response is within my area of expertise and I have not omitted to consider material facts known to me that might alter or detract from the opinions I express.

1.0 Introduction

SLR Consulting Limited (SLR) has been engaged by Genesis Energy Limited (Gensis) to prepare a district plan level regulatory assessment of hazardous substance storage and use in support of the proposal to construct and operate a solar farm at the properties identified as 304 to 508 Wall Road and 447 Motuiti Road, Foxton (the site).

The assessment is intended to support the project resource consent application and assessment of environmental effects. This purpose of this assessment is to:

- Summarise the proposed use and storage of hazardous substances at the site, and the risk/hazard that these pose to human health and the environment.
- Present a summary of measures proposed by Genesis to manage and mitigate the risk posed by the use and storage of hazardous substances at the site.
- Confirm district plan hazardous substance resource consent requirements with respect to the proposal.

The assessment has been developed based on an indicative design envelope, particularly in regard to general electrical equipment proposed to be used, and the ‘brand’ of hazardous substances used. Given this lack of surety, we have adopted a conservative approach to hazardous substance volumes, classification, and hazard management. In addition, given the scale of the proposal, the final selection of equipment should not materially influence the findings of this assessment with respect to resource consent requirements, nor the management/mitigation measures proposed.

2.0 Summary of the Proposal

Genesis proposes to build and operate an approximately 180 MWac solar facility that will generate approximately 345 GWh per year of renewable electricity.

The solar farm development will comprise 335 hectares (ha) of the 488 ha site currently used for dairy farming and runoff grazing.

The solar farm will consist of solar panels and power generation equipment arranged in rows across the site with a battery energy storage system. The renewable electricity generated will be connected to the National Grid via a new on-site substation and connection assets.

The proposed project indicatively comprises the following three components:

a) Solar:
    i. 4,200 solar tracker motors.
    ii. Either central inverter (67 number) or string inverter (150 number) units.

BESS (may be installed some years after the solar farm construction):

    iii. 66 Battery Banks, based on Canadian Solar Solbank 3.0 Battery Units. Refer Attachment A. Each battery bank will take the form of a sealed container similar to a shipping container.
    iv. 33 Power Control System Units.
    v. 11 medium voltage oil type transformers and associated switchgear.

b) Substation with high voltage transformer.

The solar farm will be owned and operated by Genesis. The new substation and connection assets will be constructed by Genesis before being transferred to Transpower.

3.0 Environmental Setting

The site is located approximately 4 km northeast of Foxton town centre, and some 23 km from Palmerston North. The site is zoned General Rural under the Horowhenua District Plan (the District Plan).

The site is located approximately 3.5 km west of the Manawatū River (and 8 km northeast of the SH1 Manawatū river crossing). The Manawatū River discharges to the coastal marine environment approximately 11.5 km west of the centre of the site.

The landcover within the site's vicinity largely comprises improved pasture, and some forestry vegetation. A few pockets of indigenous vegetation remain in the wider area with the largest being Himatangi Bush Scientific Reserve and Round Bush Reserve (Omarupapako), approximately 1.7 km north and 1.4 km southwest from the site respectively.

While the site is a predominantly flat dairy farm containing irrigated exotic pasture. Small, low value wetland areas are present across the site. The drains were likely excavated to reduce the level of saturation within paddocks that were historically wet to allow for improved pasture cover.

The land use within the site's vicinity is characterised as a working rural environment with agricultural activities, such as dairy and sheep farming, market gardening, orcharding and poultry farming being common features within the landscape, as well as forestry blocks. Silage heaps and hay bales are scattered through the landscape, consistent with the rural nature of the locality.

4.0 Summary of Proposed Hazardous Substance Storage and Use

4.1 Preface

Hazardous substance storage and use at the site will be associated with the following:

- The central inverter units and transformers will contain transformer oil.
- Battery banks comprising lithium-ion batteries, for which their cells contain a wide range of hazardous substances.
- Battery banks which will utilise ethylene glycol as a coolant.

We also note:

- Fire suppression aerosols within each battery bank are not considered to be hazardous and have not been included in this assessment.
- Above or below ground fuel storage will not be completed at the site.
- No vehicle or equipment washdown will be completed at the site.

4.2 Transformer Oil

4.2.1 Use

Transformer oils insulate, cool, and protect transformers from damage. The oil is integral to the safe operation of the units.

4.2.2 Volume

SLR have been advised that approximately 220,000 L of transformer oil will be stored within and utilised by the inverter units and transformers. Adopting a specific gravity of 0.88, approximately 194 T of transformer oil will be stored and utilised at the site.

4.2.3 Hazard Properties

Genesis has not specified a transformer oil for use at the site. Refer to Attachment B for an exemplar safety data sheet (SDS). In summary, transformer oil is:

- A clear colourless liquid.
- Stable under normal ambient temperatures.
- Not expected to be toxic unless swallowed.
- Is persistent in the environment if released and will spread in waterways as it is not soluble.

For transformer oil, a risk/hazard to human health and the environment may occur because of:

- Leaks or spills:
  - During topping up or replacement of the transformer oil.
  - As a consequence of corrosion of the transformer.

- Uncontrolled surface run-off during:
  - Heavy rainfall events.
  - Firefighting during an emergency event.

Hazard Classification

Under the Hazardous Substances and New Organisms Act 1996 (HSNO) the hazardous properties of a substance classify how a risk should be managed. Refer to Table 1 for a summary of the applicable hazard classes for transformer oil under both HSNO and the Globally Harmonised System (GHS 7)[1].

Table 1 – Transformer Oil Hazard Classification

Hazard	HSNO Classification		GHS 7 Classification
Human Health	Acute Toxicity, Inhalation	6.1E	Not applicable
Environmental	Hazardous to the Aquatic Environment, Persistence	9.1C	Hazardous to the Aquatic Environment Chronic Category 3

4.3 Lithium-Ion Batteries

4.3.1 Purpose and Number

Lithium-ion batteries within battery banks will be used to store energy from the solar panels for release when necessary.

Table 2 presents the proposed total number of lithium-ion battery cells proposed for use at the site.

Table 2 – Number of Lithium-ion Batteries Proposed for Use

Location	Number of Units	Number of Battery Cells Per Bank	Total Number of Battery Cells
Battery Banks	66	104	6,864

4.3.2 Hazard Properties

Refer to Attachment B for a copy of the manufacturer SDS for the lithium-ion batteries proposed for used at the site.

Under recommended use conditions the batteries are considered stable and non-reactive and do not pose a hazard to human health or the environment. The potential for human health or environmental risk exists when they are exposed to high temperatures, or are mechanically, electrically, or physically damaged. The hazard is only associated with the contents of the battery cell upon rupture.

Lithium-ion batteries are classified as a ‘hazardous article’, and in themselves not considered a hazardous substance when used according to the recommendations of the manufacturer. For this reason, they have not been included in the final hazardous substance regulatory assessment (refer Section 6).

[1] The HSNO Classification system was replaced by GHS 7 on 30 April 2021. However, as many district council planning documents were developed prior to 2021, these reference the historical HSNO classification system. Therefore, for the purpose of this assessment both classification systems have been included in Table C.

4.3.3 Hazard Classification

Lithium-ion batteries contain a range of hazardous substances including heavy metals, hydrogen compounds, and organic chemicals. Refer to Table 3 for a summary of the compounds within the lithum-ion batteries which are classified as hazardous including the percentage weight of the battery cell which they comprise as well as their HSNO and GHS 7 classification.

Table 3 – Lithium-ion Batteries Hazard Classification

Chemical Name	Weight (% of total cell)	HSNO Classification		GHS 7 Classification
Graphite	12.78	Carcinogenicity	6.7A	Carcinogenicity Category 1
Aluminium	6.44	Flammable Solids	4.1.1A	Flammable Solids Category 1
		Water Reactivity	4.3B	Substances and Mixtures which, in Contract with Water, Emit Flammable Gases Category 2
Copper	9.22	Acute Toxicity	6.1D	Acute Oral Toxicity Category 4
Nickel	1.18	Skin Irritation	6.3A	Skin Irritation Category 2
		Carcinogenicity	6.7B	Carcinogenicity Category 2
		Hazardous to the Aquatic Environment	9.1C	Hazardous to the Aquatic Environment Chronic Category 3
Lithium Hexafluorophosphate	2.01	Acute Toxicity	6.1C	Acute Oral Toxicity Category 3
		Skin Corrosion	8.2A	Skin corrosion Category 1A
Note: Only chemicals within lithium-ion batteries considered to be hazardous substances have been included above.				

4.4 Ethyl Glycol Coolant

4.4.1 Purpose and Volume

Each of the battery banks will contain ethyl glycol coolant, a liquid that absorbs and transfers heat away from the cells i.e., heat transfer fluid.

4.4.2 Volume

SLR has not been provided with a confirmation of the volume of ethyl glycol coolant that will be used within each battery bank. For the purpose of this assessment, we have conservatively assumed a volume of 500 L per battery bank. This equates to 33,000 L total storage at the site, split between battery banks. Adopting an assumed specific gravity of 1.1, approximately 36 T of ethyl glycol coolant will be utilised within the battery banks.

4.4.3 Hazard Properties

Refer to Attachment B for a copy for an exemplar SDS which presents a summary of relevant hazard properties. In summary, ethyl glycol coolant is:

- A clear colourless liquid.
- Not considered to be flammable or explosive.
- Stable under normal ambient temperatures.
- No expected to be toxic unless swallowed repeatedly.
- Is not considered hazardous to the aquatic environment.

For ethyl glycol coolant, a risk to human health and the environment may occur as a consequence of leaks or spills:

- During topping up or replacement of the coolant within the battery banks.
- Due to vandalism of the battery bank.
- Uncontrolled surface run-off during firefighting.

4.4.4 Hazard Classification

Refer to Table 4 for a summary of the applicable hazard classes for ethyl glycol coolant under both HSNO and the GHS 7.

Table 4 – Ethyl Glycol Coolant Hazard Classification

Hazard	HSNO Classification		GHS 7 Classification
Human Health	Acute Toxicity	6.1D	Acute Oral Toxicity Category 4
	Specific Target Organ Toxicity	6.9B	Specific Target Organ Toxicity – Repeated Exposure Category 2

5.0 Hazard Management

Given the potential hazards presented by the storage, handling, and emergency event control of the hazardous substances at the site a number of management strategies are proposed (refer Table 5). These are proposed to ensure that the storage and handling of hazardous substances at the site does not adversely effect human health or the environment. These align with the Permitted Activity requirements for the storage of hazardous substances detailed in the District Plan.

Table 5 – Proposed Hazard Management Strategies

Item Number	Management Strategy
Design Controls	
1	Battery banks will comprise sealed units limiting interaction with weather events and limiting the potential for coolant release.
2	Secondary containment will be provided for inverters and transformers using transformer oil (within the units). Containment will meet WorkSafe New Zealand requirements and equate to the full volume of the hazardous substance stored at the individual location plus at least 10% additional storage (allowance for stormwater or firewater).
Administrative Controls	
3	Spill kits containing sand and/or absorbent materials such as granules will be provided and maintained in key locations across the site.
4	Signage will be used to indicate where hazardous substances are used and stored and the risk they pose.
5	An up-to-date inventory (including volumes) of hazardous substance storage and use will be maintained at the site.
6	Up-to-date SDS records will be maintained at the site with accessibility to all site staff, to ensure risks are understood.
7	Storage and handling of all hazardous substances will be completed in accordance with SDS requirements.
8	A combined emergency response plan will be developed for the site. Should the BESS be constructed the plan will be updated to provide for battery safety. The plan will be prepared in consultation with Fire and Emergency New Zealand (FENZ) and will outline how to safely manage hazardous substances at the site. The plan will include: • A summary of site operation and associated hazards. • A summary of operational safety systems and procedures including those critical for the safe operation of the BESS including the fire protection system, battery management system, battery control interface, and thermal management system. • Detailed emergency response guidance for on-site first responders and FENZ staff. • Contact numbers for responsible parties. Procedures for maintenance and upgrade activities. • Spill management and clean up procedures. • Procedures for regulatory reporting post emergency event.
9	Disposal of any used hazardous substance containers will be to licensed facilities authorised to accept such materials. The containers will not be washed out on site.
10	Decommissioned battery cells will be removed from the site and disposed to licensed facilities authorised to accept such materials. Decommissioned batteries will be stored under cover, on hard stand areas, pending removal from the site.
11	Site staff will be provided with appropriate and ongoing training with respect to the above, with records maintained by management. Staff required to handle hazardous substances will be provided with training and appropriate personal protective equipment (PPE). The training will include the correct use of the PPE supplied. Decommissioned battery cells will be removed from the site and disposed to licensed facilities authorised to accept such materials. Decommissioned batteries will be stored under cover, on hard stand areas, pending removal from the site.

6.0 District Plan Regulatory Assessment

The Operative Horowhenua District Plan 2015 (the District Plan) contains objectives, policies, and rules for managing land use and development in the district. The rules of the District Plan set out what activities can be completed as of right (permitted activities) and what activities will require a resource consent.

The hazardous substances section of the District Plan includes objectives, policies and methods, rules and performance standards relating to the use and storage of hazardous substances (relative to HSNO Classifications) across various zonings.

Rule HAZ-HS-R2 of the District Plan states that an activity will be considered discretionary if the storage of hazardous substances exceeds those specified in the discretionary column identified in Chapter 2.6: Hazardous Substances Appendix 1 - 'Table 2.6-2: Quantity Limits for Hazardous Substances.

As illustrated in Table 6, the proposed volume of transformer oil and ethyl glycol coolant exceeds the maximum volume limits in the discretionary column of Table 2.6-2 for the Rural Zone. We therefore conclude that a Discretionary Activity resource consent is required under the District Plan to authorise the proposal.

Table 6 – Summary of Proposed Hazardous Substance Use and Storage against the Activity Thresholds of the District Plan

Hazardous Substance	District Plan Applicable HSNO Classification		Discretionary Activity Maximum Volume (Tonnes)	Anticipated Volume (Tonnes)
Transformer Oil	Hazardous to the Aquatic Environment	9.1C (liquid, over 30 metres from a watercourse)	60	**194**
Ethyl Glycol Coolant	Acute Toxicity	6.1D (liquid)	18	**36**

7.0 Limitations

This report has been prepared by SLR Consulting New Zealand Limited (SLR), on the instruction of Genesis Energy (the Client), in accordance with the agreed scope of work. It is intended to support the Client's application under the Fast Track Approvals Act 2024 and may be relied upon by the Expert Panel and relevant administering agencies for the purposes of assessing the application. While SLR has exercised due care in preparing this report, it does not accept liability for any use of the report beyond its intended purpose. Where information has been supplied by the Client or obtained from external sources, it has been assumed to be accurate unless otherwise stated.

8.0 Conclusions

Genesis proposes to construct and operate a solar farm at the properties identified as 304 to 508 Wall Road and 447 Motuiti Road, Foxton. As part of site operations hazardous substances will be used including:

- Inverter units and transformers that will contain transformer oil.
- Battery banks comprising lithium-ion batteries (for which their cells contain a wide range of hazardous substances) that will be cooled using an ethylene glycol product.

With respect to regulatory requirements a Discretionary Activity resource consent is required under the District Plan to authorise the storage and use of hazardous substances associated with the proposal (Rule HAZ-HS-R2).

The hazard posed to human health and the environment by the use and storage of the hazardous substances at the site will be managed and mitigated through the implementation of engineering (secondary containment, sealed battery banks) and administrative controls (management plans, training) as outlined in Table 5 of this report.

9.0 Closure

Should you require any further clarification please contact the undersigned.

Regards,

SLR Consulting New Zealand

Emma Trembath
Technical Director – Waste Management

Nigel Mather
Technical Discipline Manager – Environmental Services

Attachment A

E-STORAGE
ENERGY STORAGE SOLUTION

FIRE SAFETY SYSTEM AND BMS OVERVIEW

CanadianSolar
MAKE THE DIFFERENCE

e-STORAGE
A subsidiary of Canadian Solar

SEPTEMBER 2023

PRODUCT HIGHLIGHTS

MODULAR, ALL IN ONE, HIGH DENSITY

Extended Battery Life

We use durable, high cycling capacity LFP battery cell with proven long life track record and up to 20 years warranty.

- Active balancing BMS on cell level ensures a balance between all batteries during daily operation.
- A hybrid liquid + air cooling system maintains optimal temperature and humidity throughout the lifetime of the project.

Thorough Safety Design

Built to meet the latest fire and safety codes in the U.S., China, UK and Australia markets. SolBank units include:

- Complete fire propagation verification from cell, module (pack) to unit level based on the latest UL 9540A: 2019 (4th Edition).
- Explosion prevention systems via gas detection, active venting and passive pressure relief.

With integrated multi-level fire detection, units provide:

- Timely fire detection.
- Reporting of fire incidents.
- Linked actions with other system components.

Reduced Onsite Work

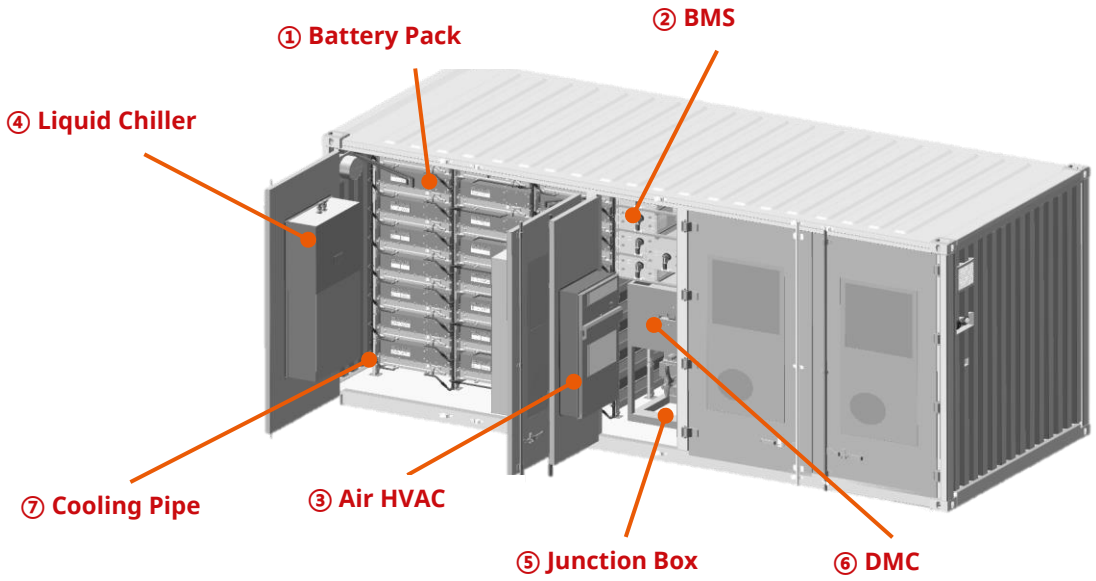
- All components are shipped with the product after factory testing, simplifying the installation and commissioning process onsite.
- All external wirings are available in a central location at the bottom of the enclosure.

Modular

- Scalable modular design from 1.5 hour to 6+ hour duration with high density and back-to-back installation;
- One standard platform for multiple power/duration applications, designed to meet global market performance and safety requirements.

SOLBANK

BATTERIES SHIP IN ENCLOSURE, 3 PRODUCT LINES



Parameter-Model	SolBank-S-2967-4h	SolBank-S-2967-2h	SolBank-S-2967-1.5h
System Configuration	8P414S (8 Racks)	8P414S (8 Racks)	6P414S (6 Racks)
Rated DC Voltage Range	1159.2V~1490.4 V		
Rated DC Power	700 kW	1375 kW	1300 kW
Nominal Capacity	2967 kWh	2967 kWh	2225 kWh
DC Usable Capacity (FAT)	**2800 kWh**	**2750 kWh**	**1950 kWh**
Constant Power (CP) Rate	**0.25P (4 hours)**	**0.5P (2 hours)**	**0.67P (1.5 hours)**
DC Round Trip Efficiency (RTE)	94%	93%	91%

Thermal Management System	Liquid cooling/heating for battery system, air cooling for electrical components and humidity control	
Enclosure Ingress Rating	IP55 / NEMA 3R	
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)	
Enclosure	20ft. high-cube container	
Weight (Battery Included)	29,800 kg (65,700 lbs)	24,900 kg (54,895 lbs)
Seismic Parameter	Zone 4	
Noise @1m distance	≤75 dB	

* BMS: Battery Management System

DMC: Distribution Management System

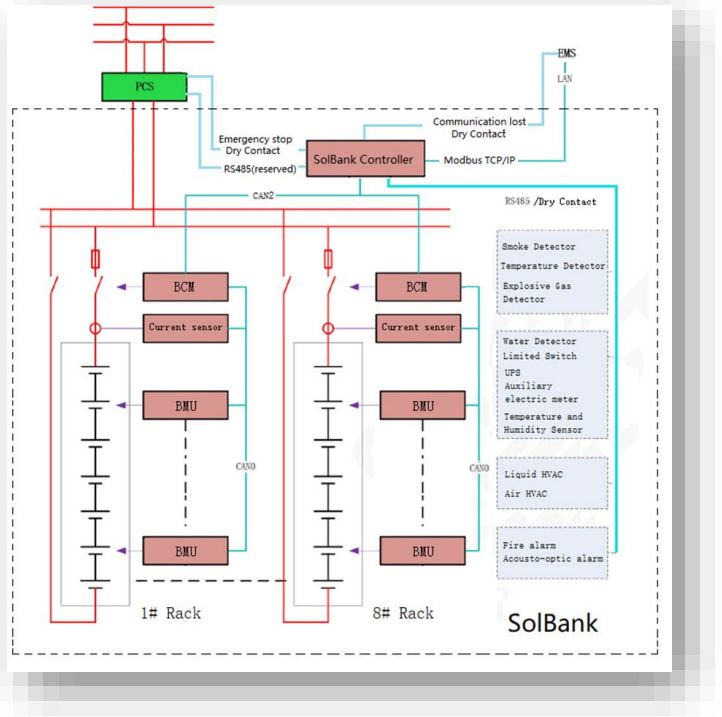
CONTROL AND MONITORING

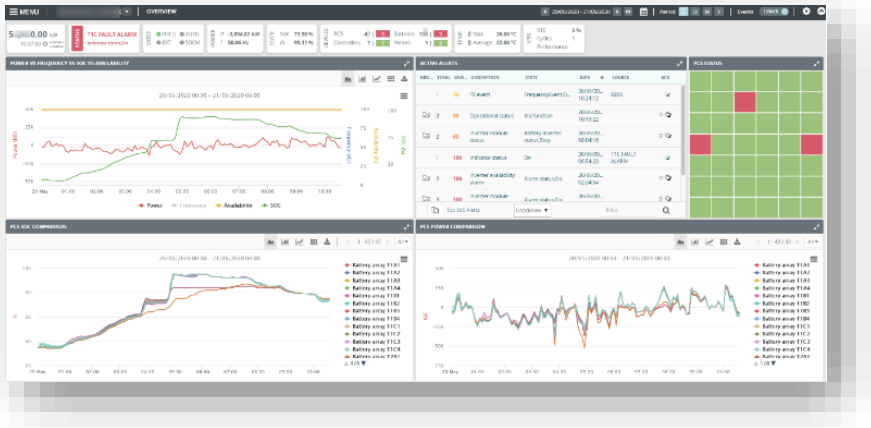
Battery Management System (BMS)

- Monitors battery status to cell level in real time, including temperature, voltage, power level, fault and alarms, protections
- Report any faults, alarms to the control and monitoring system (BCI and EMS)
- Built in UPS for monitoring during power outage

Battery Control Interface (BCI)

- Control the inverter and SolBank in real time, coordinate behaviors between these components
- Stop all inverter and SolBanks within the same energy station when there is a fire alarm, minimize fault impact





Energy Management System

- Monitors status of all BESS equipment and report any fault detected to the operator
- Allow service team to read and analyze operating data of the equipment, to optimize system health and identify issues from early stage

PRIMARY BESS CODES & STANDARDS

Installation Codes and Standards

- **NFPA 855 Standard for the Installation of Energy Storage Systems (2023 Edition)**
- **2021 International Fire Code (IFC) Chapter 12 – Section 1207**

**Required code / standard and editions may vary based on state or jurisdiction.*

Listings / Certifications for ESS and Associated Equipment:

- **UL 9540:** Standard for Energy Storage Systems and Equipment

  Includes:
  - UL 1973 for cell, battery, rack
  - UL 1741 for inverters

Large-Scale Fire Testing:

- **UL 9540A:** Standard for Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems

INTEGRATED SAFETY SYSTEM

Certification-Standard

- Battery Cell, Module and Rack – **UL1973, IEC62619, UL1642**
- SolBank - **UL9540, UL9540A** (cell, module, unit level), **UN38.3**
- SolBank Explosion Prevention System – **NFPA69**
- Inverter – **UL1741**
- Integrated system – **UL9540**

Independent Engineering Report

- SolBank product review - DNV

DNV

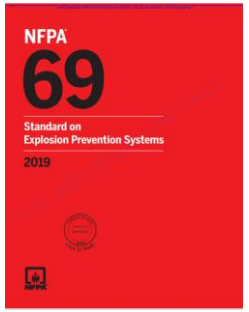
Owner Support under Long Term Service Agreement (LTSA)

- 24*7 monitoring of the system through CSI remote operation center
- O&M service with preventive maintenance and corrective maintenance of the equipment
- Onsite and remote training to ensure adequate professionalism of O&M team members

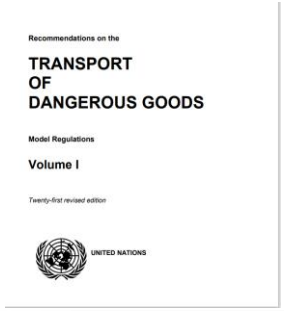
Site Specific Materials

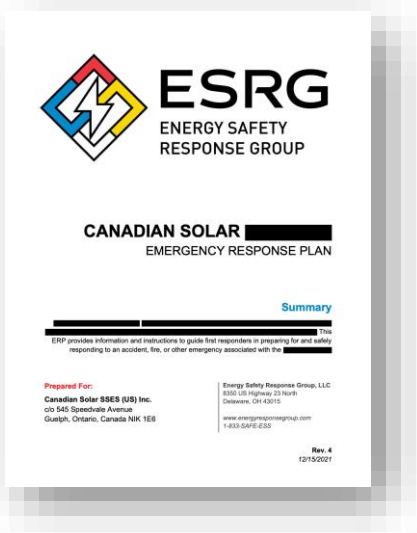
- Site specific Emergency Response Plan (ERP)
- Site specific Hazard Mitigation Analysis (HMA)

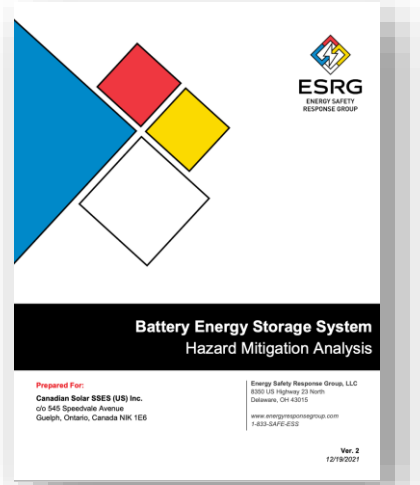
UL 1973, Edition 3



UL 9540, Edition 2







UL9540A LARGE-SCALE FIRE TESTING

UL 9540A Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems:

Developed to better understand safety risks, demonstrate compliance with codes and standards

▪Testing performed at multiple levels:
- Cell
- Module
- Unit
- Installation*

▪Test results inform system design and installation requirements
-Fire mitigation and protection
-Ventilation
-Incident management

Test Level	Reported Information / Performance Criteria
Cell	• Can cell exhibit thermal runaway? • Thermal runaway characteristics • Flammability / composition of vent gas
Module	• Thermal runaway containment / characteristics • Flammability / composition of vent gas • Heat and gas release rates
Rack / Unit	• Evaluation of fire / thermal runaway spread • Heat and gas release rates • Deflagration and re-ignition behavior
Installation	• Effectiveness of fire protection systems • Heat and gas release rates • Deflagration and re-ignition behavior

UL9540A REPORTS

UL 9540A, Edition 4

Test Result high level summary

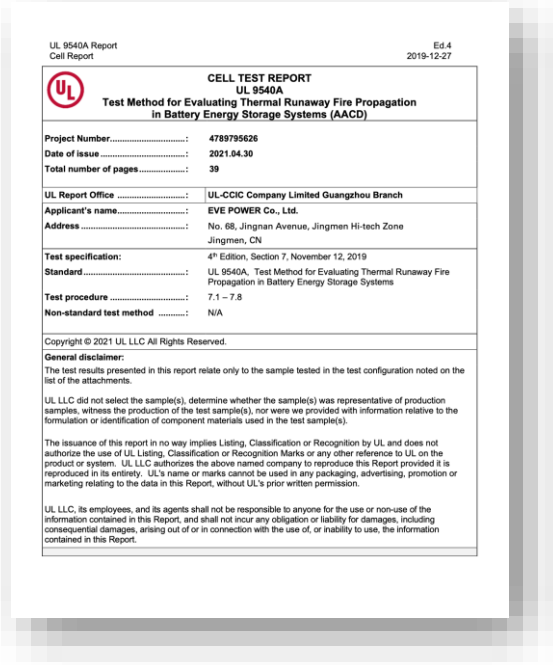
UL9540A – Unit level

- Cell to cell propagation was happened in the initiating model.

  Note: It is forced cell to cell propagation introduced purposely to complete the UL9540A test on unit level.

- Module to module propagation was not observed.
- No flying debris or explosive discharge of gases observed during test.
- No sparks, electrical arcs, or other electrical events observed during test.
- No external flaming was observed during test.

Note: Please refer to the reports for more details.



UL 9540A Report
Cell Report
Ed.4
2019-12-27

CELL TEST REPORT
UL 9540A
Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems (AACD)

Project Number	4789795626
Date of issue	2021.04.30
Total number of pages	39
UL Report Office	UL-CCIC Company Limited Guangzhou Branch
Applicant's name	EVE POWER Co., Ltd.
Address	No. 68, Jingnan Avenue, Jingmen Hi-tech Zone Jingmen, CN
Test specification:	4th Edition, Section 7, November 12, 2019
Standard	UL 9540A, Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems
Test procedure	7.1 – 7.8
Non-standard test method	N/A

General disclaimer:

The test results presented in this report relate only to the sample tested in the test configuration noted on the list of the attachments.

UL LLC did not select the sample(s), determine whether the sample(s) was representative of production samples, witness the production of the test sample(s), nor were we provided with information relative to the formulation or identification of component materials used in the test sample(s).

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UL9540A-Cell level

TÜVRheinland®

Prüfbericht-Nr.: Test Report No.:	CN22KVMN001	Auftrags-Nr.: Order No.:	244359092
Kunden-Referenz-Nr.: Client Reference No.:	2371109	Auftragsdatum: Order date.:	Sep 06, 2021
Auftraggeber: Client:	CSI Energy Storage Co., Ltd. 199, Lushan Road, SND, Suzhou City, Jiangsu, P.R. China		
Prüfgegenstand: Test item:	LFP battery module		
Bezeichnung / Typ-Nr.: Identification / Type No.:	CSI-SolBank-P220200A01		
Auftrags-Inhalt: Order content:	Test report		
Prüfgrundlage: Test specification:	UL 9540A: 2019 (Fourth Edition)		
Wareneingangsdatum: Date of receipt:	Dec 22, 2021		
Prüfmuster-Nr.: Test sample No.:	2021120706		
Prüfzeitraum: Testing period:	Dec 22, 2021 ~ Dec 23, 2021		
Ort der Prüfung: Place of testing:	See clause 1.1 of main report		
Prüflaboratorium: Testing laboratory:	See clause 1.1 of main report		
Prüfergebnis*: Test result*:	See main report		

Seite 1 von 35 / Page 1 of 35

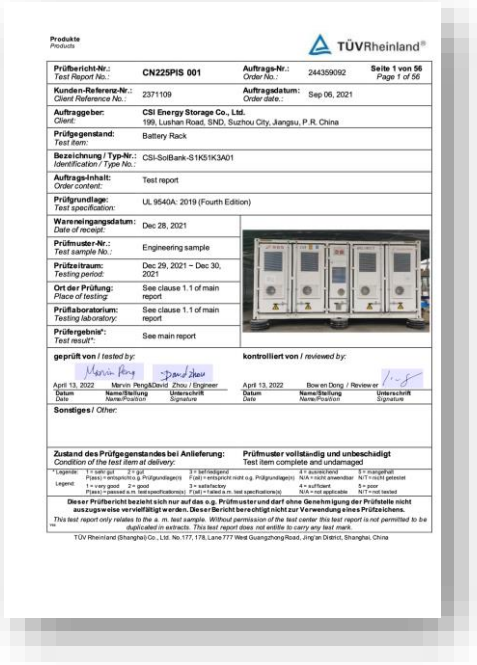
geprüft von / tested by: Marvin Peng &David Zhou/ Engineer, April 13, 2022

kontrolliert von / reviewed by: Bow en Dong / Review er, April 13, 2022

Sonstiges / Other:

Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery: Prüfmuster vollständig und unbeschädigt / Test item complete and undamaged

UL9540A-Module level



TÜVRheinland®

Prüfbericht-Nr.: Test Report No.:	CN225PIS 001	Auftrags-Nr.: Order No.:	244359092
Kunden-Referenz-Nr.: Client Reference No.:	2371109	Auftragsdatum: Order date.:	Sep 06, 2021
Auftraggeber: Client:	CSI Energy Storage Co., Ltd. 199, Lushan Road, SND, Suzhou City, Jiangsu, P.R. China		
Prüfgegenstand: Test item:	Battery Rack		
Bezeichnung / Typ-Nr.: Identification / Type No.:	CSI-SolBank-S1K51K3A01		
Auftrags-Inhalt: Order content:	Test report		
Prüfgrundlage: Test specification:	UL 9540A: 2019 (Fourth Edition)		
Wareneingangsdatum: Date of receipt:	Dec 28, 2021		
Prüfmuster-Nr.: Test sample No.:	Engineering sample		
Prüfzeitraum: Testing period:	Dec 29, 2021 ~ Dec 30, 2021		
Ort der Prüfung: Place of testing:	See clause 1.1 of main report		
Prüflaboratorium: Testing laboratory:	See clause 1.1 of main report		
Prüfergebnis*: Test result*:	See main report		

Seite 1 von 56 / Page 1 of 56

geprüft von / tested by: Marvin Peng&David Zhou / Engineer, April 13, 2022

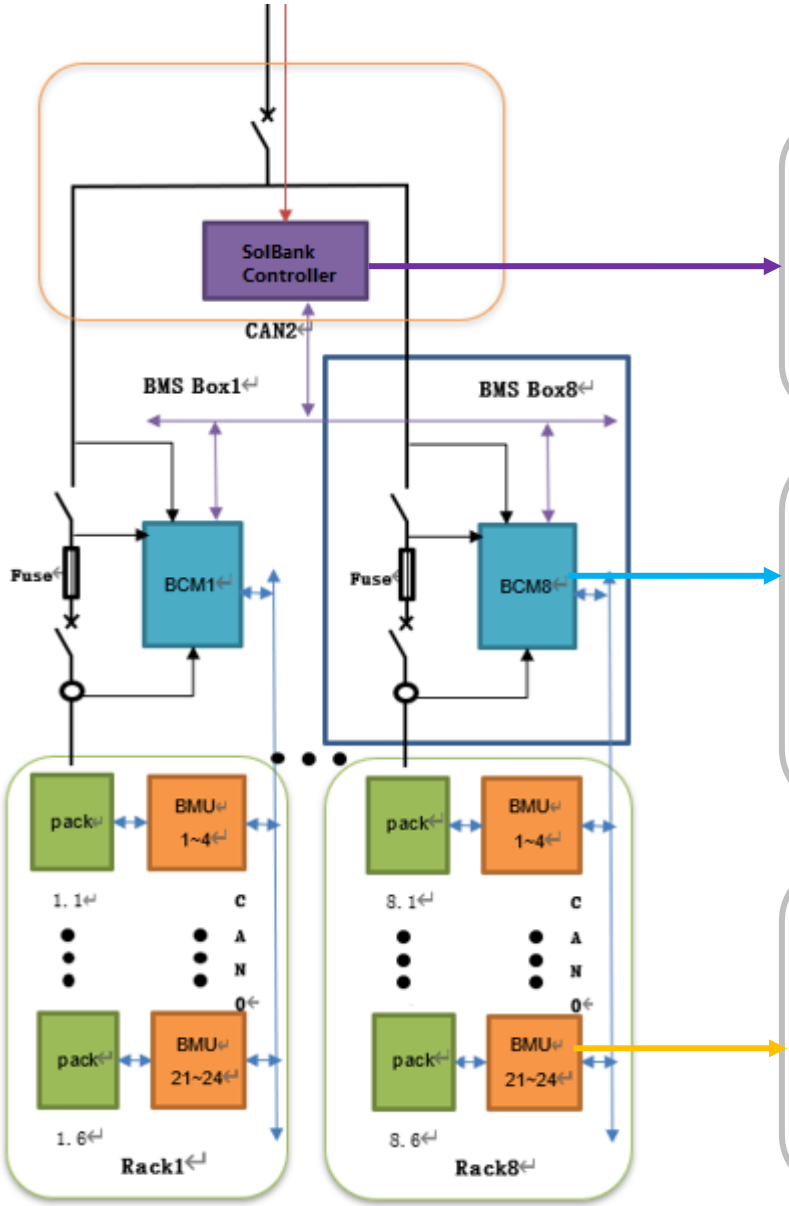
kontrolliert von / reviewed by: Bow en Dong / Review er, April 13, 2022

Sonstiges / Other:

Zustand des Prüfgegenstandes bei Anlieferung: Condition of the test item at delivery: Prüfmuster vollständig und unbeschädigt / Test item complete and undamaged

UL9540A-Unit level

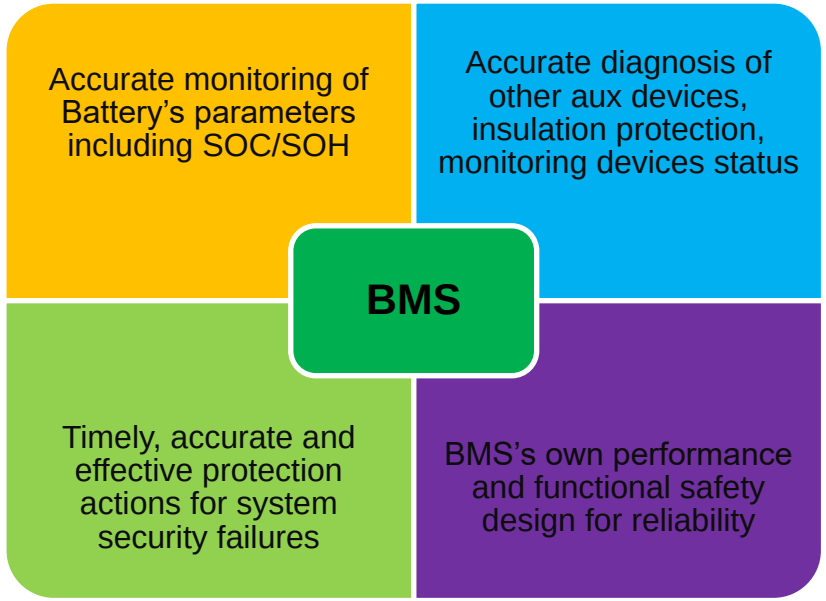
BMS SAFETY OVERVIEW



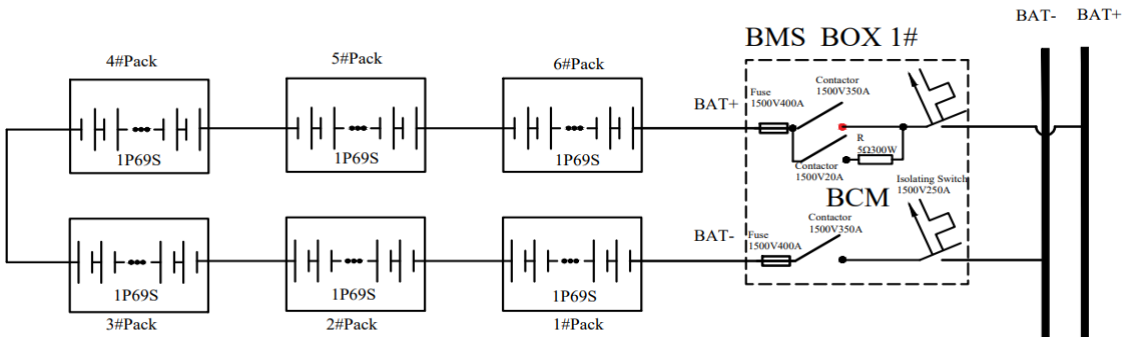
- Battery Rack status judgment
- Confirm battery Rack start and stop conditions
- Battery system current limit management
- Battery system SOC estimation

- Rack current acquisition
- SOC calculation
- High and low voltage protection
- Over temp. protection
- Balance strategy judgment
- Temp management system
- Rack current limit judgment

- Cell voltage collection
- Cell temperature acquisition
- Balance function execution



BMS SAFETY OVERVIEW

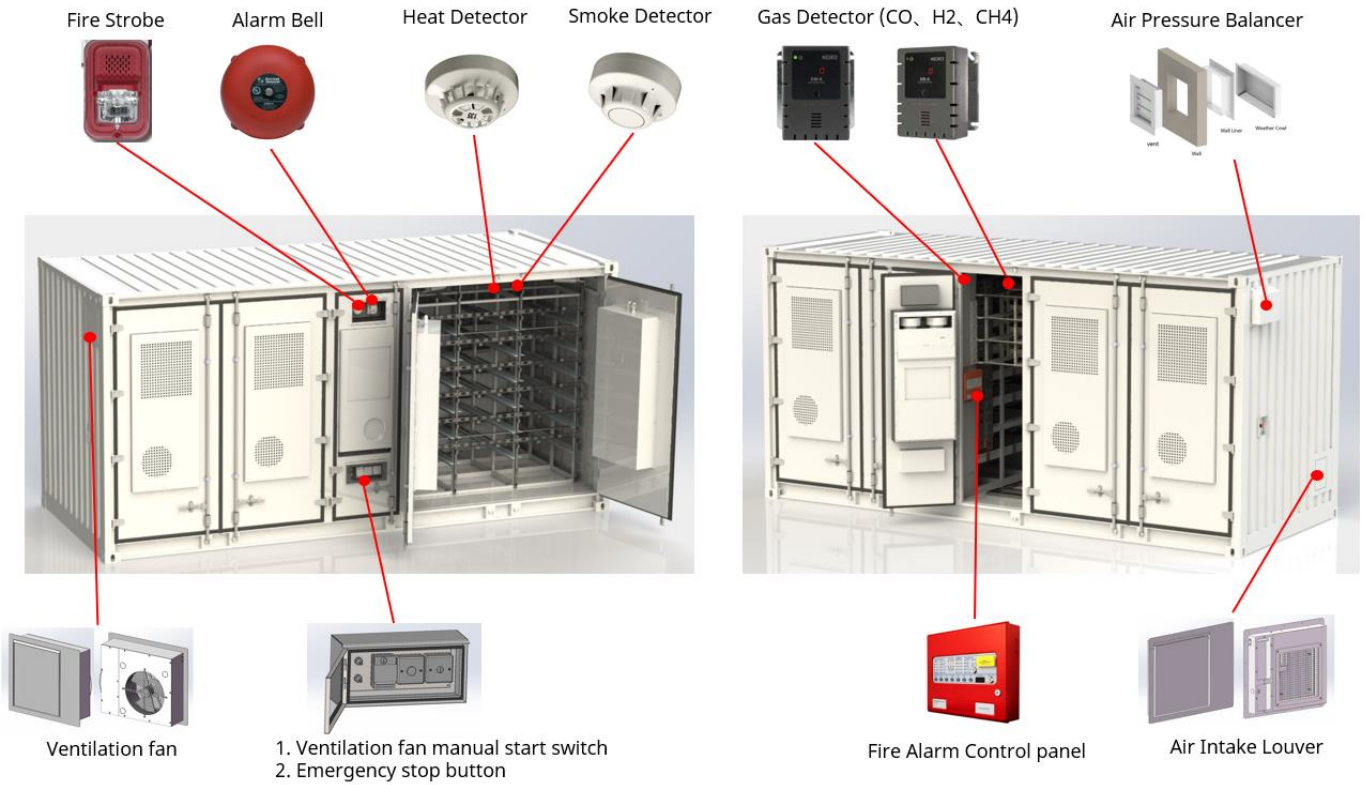


Level	Safety design
Rack level	1. Battery string short circuit protection (fuse)
	2. Dual Fuse redundancy design
	3. The relay is allowed to open under load under abnormal conditions
	4. Battery string switch allows disconnection under load
	5. DC insulation monitoring function
	6. Software meets UL60730 functional safety design requirements

BMS FAULTS ALARM LIST

No.	Item	Alarm level	Alarm trigger threshold	Alarm Regression value	Trigger duration	System control action	Fault alarm clearing condition	Fault alarm clearing condition (No Charging and Discharging)
1	Cell high voltage (V)	Level 1	3.55V	0.2V	3 sec	Report to the alarm	Alarm triggering threshold - Regression value	/
		Level 2	3.6V		3 sec	No charging; Allow discharging	Alarm triggering threshold - Regression value	Alarm clear and (All strings have discharge current or the average voltage of current, string cells is less than 3.3V)
		Level 3	3.65V		3 sec	Output dry point, delay 3 sec disconnect contactor	Alarm triggering threshold - Regression value	ESMU click "Fault recovery"
2	Cell low voltage (V)	Level 1	2.9V	0.2V	3 sec	Report to the alarm	Alarm triggering threshold + Regression value	/
		Level 2	2.8V		3 sec	No discharging; Allow charging	Alarm triggering threshold + Regression value	Alarm clear and all strings have charging current
		Level 3	2.55V		3 sec	Output dry point, delay 3 sec disconnect contactor	Alarm triggering threshold + Regression value	ESMU click "Fault recovery"
3	Cell voltage difference(mV)	Level 1	300mv	50mv	3 sec	Report to the alarm	Alarm triggering threshold -	/
							Regression value	
		Level 2	400mv		3 sec	No charging; Prohibited discharge	Alarm triggering threshold - Regression value	Alarm clear and delay 30 min
		Level 3	600mv		3 sec	Output dry point, delay 3 sec disconnect contactor	Alarm triggering threshold - Regression value	ESMU click "Fault recovery"
4	Battery high temperature(℃)	Level 1	40	5℃	3 sec	Report to the alarm	Alarm triggering threshold - Regression value	/
		Level 2	45	15℃	3 sec	No charging; Prohibited discharge	Alarm triggering threshold - Regression value	Alarm clear
		Level 3	50	20℃	3 sec	Output dry point, delay 3 sec disconnect contactor	Alarm triggering threshold - Regression value	ESMU click "Fault recovery
5	Battery low temperature(℃)	Level 1	10	5℃	3 sec	Report to the alarm	Alarm triggering threshold + Regression value	/
		Level 2	5	10℃	3 sec	No charging; Prohibited discharge	Alarm triggering threshold + Regression value	Alarm clear
		Level 3	0	15℃	3 sec	Output dry point, delay 3 sec disconnect contactor	Alarm triggering threshold + Regression value	ESMU click "Fault recovery
6	Battery temperature difference(℃)	Level 1	10	5℃	3 sec	Report to the alarm	Alarm triggering threshold - Regression value	/

FIRE PROTECTION SYSTEM SAFETY - EQUIPMENT



Safety features

- Fire detection (smoke + heat detectors)
- Fire alarm (remote and local)
- Explosion prevention (combustible gas detection, active ventilation)
- Emergency shutdown (E-Stop)
- Non-walk-in container design with open door sensors
- Lockable disconnect switch for LOTO

Redundancy designs

- Two sets of smoke, heat detectors, trigger of any will report fire alarm
- Two gas detectors, trigger of any will report gas alarm
- Built in UPS for battery monitoring, ventilation, fire detection and alarming
- Backup aux power supply for fire safety system

Fire Detection	Heat and Smoke detection (2 Sets)
Explosion Prevention & Mitigation	Gas detection (2 Units), passive pressure relief system, active air intake and venting
Fire Alarm	Strobes and bells - UPS Backup. Fire alarms monitored by both fire panel and BMS
Local Emergency Stop	Yes
Coolant Leak Detection	Yes
Interface with External Fire Panel	Available with options to network

FIRE PROTECTION SYSTEM SAFETY - EQUIPMENT

POTTER
The Symbol of Protection

Fire Panel Features

- NFPA 72 Compliant Smoke Sensitivity Test Built-In
- Dedicated Alarm, Supervisory and Trouble Relays
- NFPA, 12, 12A, 13, 15, 16, 17, 17A, 70, 72, 92, 720 ,750, and 2001

MACURCO™
Building & Home Solutions

Grey Housing (Standard)

Intertek

Gas Detector Features

- Designed for low-level detection, mitigation, and notification
- Gas Type: Propane (LP) Methane (NG) Hydrogen (H2)
- Gas Range: 0-50% LEL
- ELT Listed

POTTER
The Symbol of Protection

LISTED

Smoke Detector Features

- Wide selectable sensitivity range of 1.0 to 3.7%/foot
- UL listed smoke calibration and sensitivity
- UUKL Listed for Smoke Control

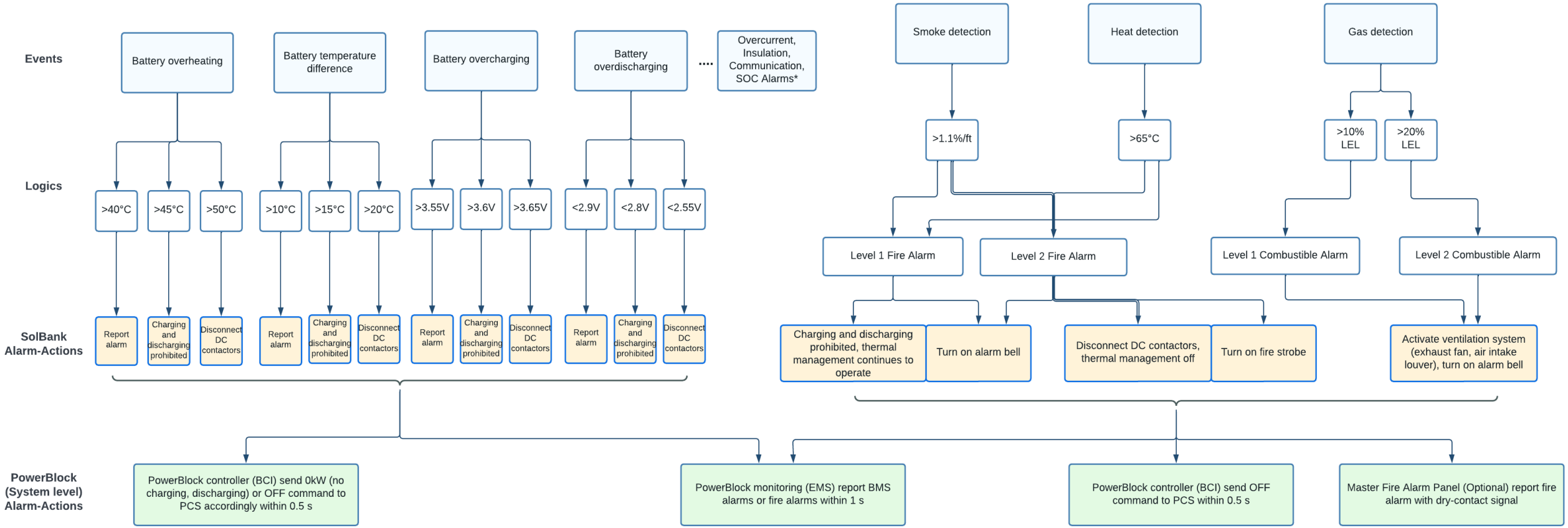
POTTER
The Symbol of Protection

FM
APPROVED
LISTED

Heat Detector Features

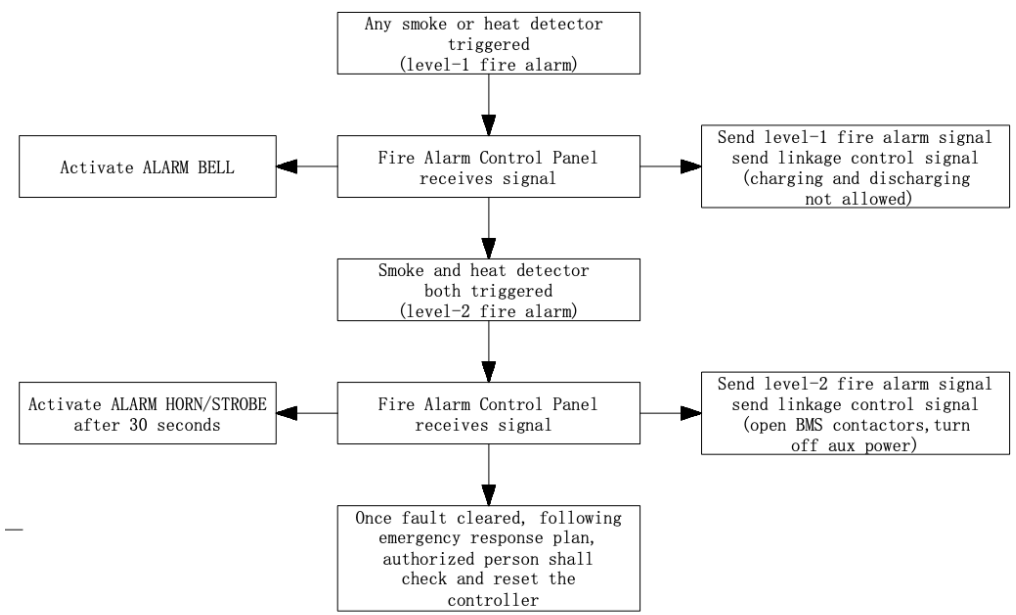
- Selectable Rate of Rise and/or Fixed Heat Detector
- UUKL Listed for Smoke Control

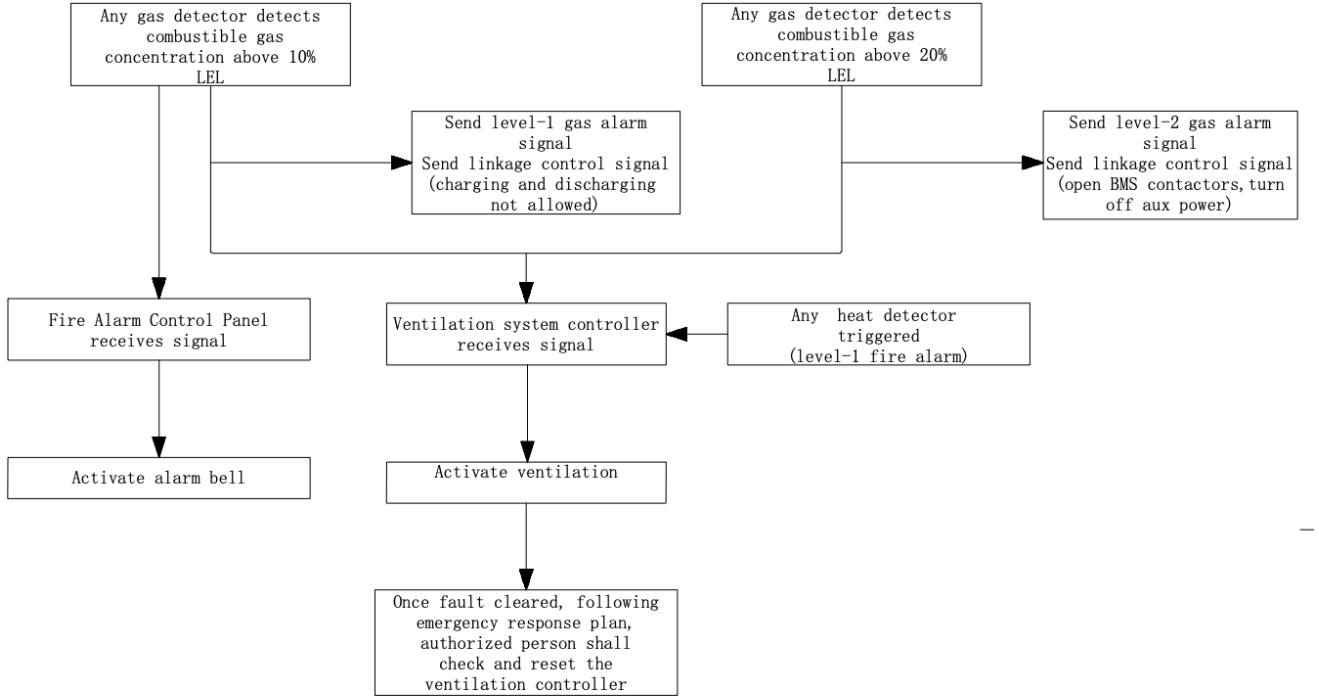
FIRE PROTECTION SYSTEM SAFETY - LOGIC MAP



- Note: *This overview has included examples for BMS alarms, for complete list of alarms and monitoring datapoints, please refer to BMS alarm list.
- For charge and discharge cell voltage limits, SolBank strictly follows Cell Supplier recommendations. *For details, please refer to EVE LF280K cell datasheet.*
- Charge limit for cell spec: 3.65V, SolBank charge limit alarm starts from 3.55V, no charge on 3.6V.
- Discharge limit for cell spec: 2.5V, SolBank discharge limit alarm starts from 2.9V, no discharge on 2.8V.
- Accuracy and delay of BMS detection: BMS voltage accuracy 5 mv; Current accuracy 0.5 %; Temperature accuracy 1°C. BMS components use CAN bus for communication internally, which has a delay of less than 0.5s (CAN 2.0 communication).

FIRE PROTECTION SYSTEM SAFETY - FIRE CONTROL FLOW CHART





EVENT TIMELINE DESCRIPTION

Prevention of Event: Phase 1

- Tightly designed control system: no violation of battery operation limit (voltage deviation, duty cycle, etc)
- SolBank BMS detects abnormal battery in early stage, report status to trigger warning or alarm
- SolBank auxiliary system reports abnormal status of aux components (i.e. HVAC failure, and report issue through BMS-EMS)
- 24*7 monitoring and corrective maintenance: ensure issues got identified and addressed timely

Limit Extent of Event: Phase 2

- SolBank with fault will be stopped: including level 1 fire alarm, level 1 gas alarm, over temperature, high/low SOC
- SolBank with critical fault will be disconnected: including level 2 fire alarm, level 2 gas alarm, severe high/low voltage or SOC
- Any detection of combustible gas to a certain level will trigger linkage control signal to start active ventilation
- Any communication issue with SolBank, PCS or EMS will be reported, and impacted equipment will be stopped.

Conclude Event: Phase 3

- Initiation of emergency response shall be activated per current protocol. If there is any threat or potential threat to life or safety, 911 shall be called immediately to summon the aid of public safety responders.
- With a confirmed fire alarm, the site should be evacuated with all staff to the the primary muster point per Emergency Response Plan (ERP)
- Subject Matter Expert (SME) shall be informed to provide advice to first responder based on the site-specific information per Emergency Response Plan (ERP)
- O&M team continues to monitor equipment status of impacted unit and units next to it through EMS remotely

SOLBANK FIRE SAFETY SOLUTION ADVANCEMENTS

Sr.	Standard Requirement	SolBank Advancement
1	NFPA855 requirement on ventilation states: *"9.6.5.1.4* Natural Exhaust Ventilation. Exhaust ventilations shall be designed to limit the maximum concentration of flammable gas to 25 percent of the lower flammable limit (LFL) of the total volume of the outdoor cabinet during the worst-case event of simultaneous "boost" charging of all the batteries, in accordance with nationally recognized standards."*	SolBank complies with NFPA855 requirements and exceeds the minimum condition by lowering the gas concentration detection limit LFL to 10%
2	NFPA855 requirement on smoke and fire detection states: *"9.6.1 Smoke and Fire Detection. Areas containing ESS systems located within buildings or structures shall be provided with a smoke detection or radiant energy-sensing system in accordance with Section 4.8, unless modified by this chapter."*	SolBank complies with NFPA855 requirements and exceeds the minimum condition by including Smoke detector as well as Heat detector in the SolBank.

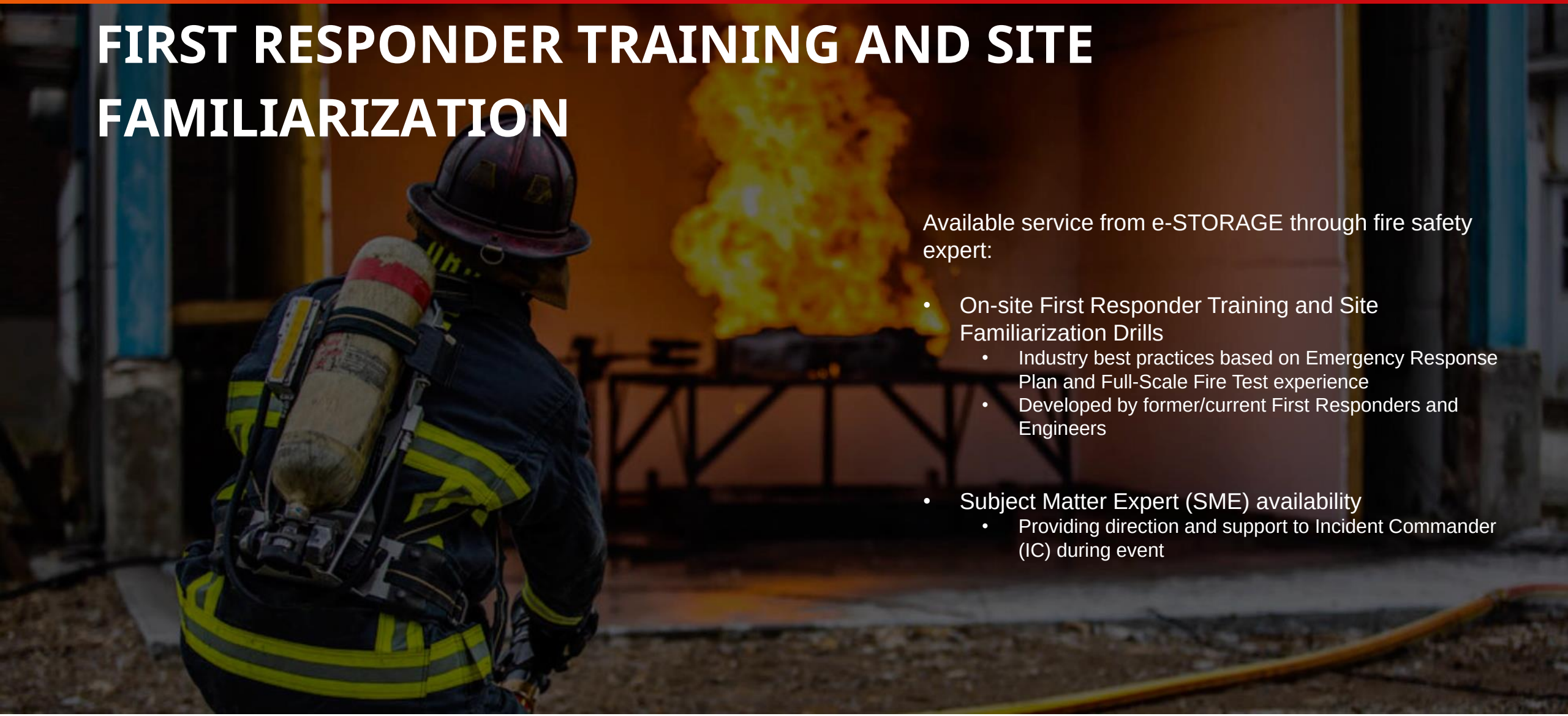
BESS FAILURE AND FIREFIGHTING

- SolBank does not require a suppression system to make it a safer product. However, in the unlikely event of fire, we can adopt “let it burn” fire safety approach. An on-site water reservoir is agreed upon early in the project with the local fire department to manage the spread of fires to the adjacent areas.

- Suppression, however, will likely be defensive in nature, protecting adjacent enclosures while the effected system burns itself out

    - Testing has not shown electrical leakage to be an issue at the voltages ESS operates for firefighting safety
    - Testing on water runoff is on-going but has so far not been overly negative
    - Water can be used as fire suppression agent for surrounding area.
    - Foam is more conductive, has not performed well in the field
    - Other water-based agents have not shown they perform better than water
    - Alternative agents (non-water based) don’t provide the cooling of water

FIRST RESPONDER TRAINING AND SITE FAMILIARIZATION



Available service from e-STORAGE through fire safety expert:

- On-site First Responder Training and Site Familiarization Drills
  - Industry best practices based on Emergency Response Plan and Full-Scale Fire Test experience
  - Developed by former/current First Responders and Engineers

- Subject Matter Expert (SME) availability
  - Providing direction and support to Incident Commander (IC) during event

e-STORAGE

A subsidiary of Canadian Solar

UTILITY-SCALE ENERGY STORAGE

SolBank 3.0

ENERGY STORAGE SYSTEM

S-5016-2H-NA|S-5016-4H-NA

Capacity: 5.0 MWh

e-STORAGE, a subsidiary of **Canadian Solar**, is a world-class energy storage solution provider, specializing in storage system design, manufacturing, and integration of battery energy storage systems for utility-scale applications.

The company offers value-added system consulting and turnkey EPC services, in addition, we provide customers with our proprietary LFP battery solution SolBank.

Together, we are building a brighter, greener future for all.

SolBank 3.0 Highlights

- **Cutting-Edge Technology**: SolBank 3.0 features high-density LFP cells, an active balancing BMS, and an innovative liquid cooling TMS, ensuring optimal safety.

- **Compliance and Certifications**: SolBank 3.0 adheres to all industry standards: NFPA855, NFPA69, NFPA72, NFPA70E, and optional NFPA68. Certified under UL1973, UL9540, UL9540A, UN38.3/UN3536, ensuring rigorous safety and performance criteria.

Key Features

Enhanced Energy Density

- Utilizes 314 Ah battery cells and compact integration, increases single container energy density up to 45%
- Reduces land cost by up to 35% in a 100MWh project

Safety

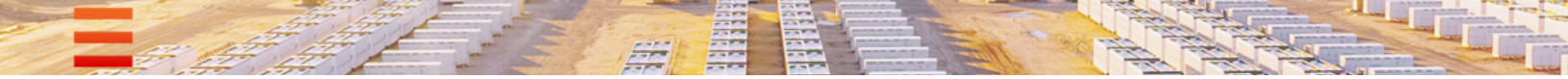
- IP67-rated pack design
- Up to 20% faster detection of abnormal and automatic protection
- Advanced pack thermal isolation, electrical redundancy protection, and multi-level fire protection, effectively minimize potential issues

Intelligent Control

- Liquid cooling cuts auxiliary consumption up to 30%
- Active balance and string-level management, guarantee high efficiency and availability

Compatibility & Installation

- Supports various PCS topologies
- Turn-key integration and stationery certification, reduce project schedule risks by up to 40%
- Plug-and-play setup for streamlined commissioning



SolBank 3.0
System Parameter

e-STORAGE
A subsidiary of Canadian Solar

General		
Product Model	CSI-SolBank-S-5016-2h-NA	
	CSI-SolBank-S-5016-4h-NA	
Battery Chemistry	Lithium Iron Phosphate (LFP)	
Pack Configuration	1P104S (104 Cells)	
Rack Configuration	1P416S (4 Packs)	
System Configuration	12P416S (12 Racks)	
Nominal DC Voltage	1331.2 V	
Operation DC Voltage Range	1164.8 V ~ 1497.6 V	

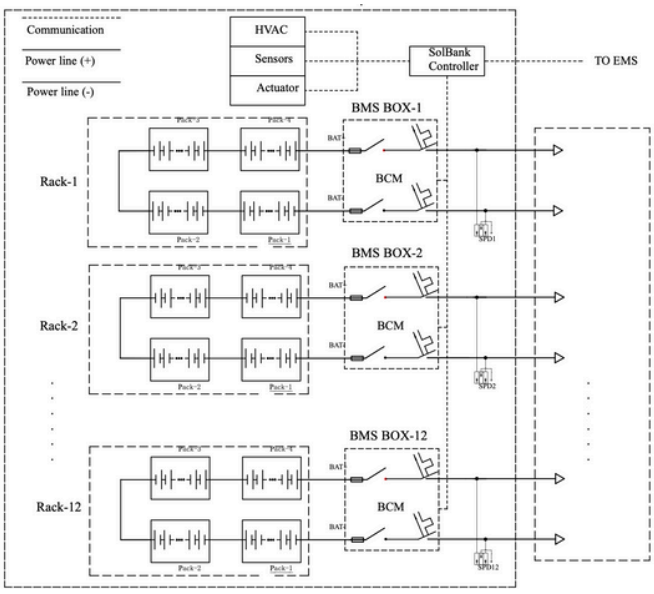
Performance		
Charging/Discharging Mode	0.5 P / 0.5 P	0.25 P / 0.25 P
Rated DC Power	2350 kW	1200 kW
Initial Storage Capacity	4700 kWh	4800 kWh
Duration @Rated DC Power	2hrs	4hrs
Round Trip Efficiency (RTE)	93%	94%
Auxiliary Load (Standby/Peak)	1.5 kVA / 50 kVA	1.5 kVA / 22 kVA
Max. Short Circuit Current	10 kA*12	10 kA*12
Operating Temperature (Ambient)	-30 °C to 55 °C (derating from 45°C to 55°C)	
Relative Humidity	≤95% (non-condensing)	
Altitude	≤4000 m (derating from 2000 m to 4000 m)	
Noise Sound Pressure Level (LPA) at 1 meter distance	≤75 dB(A)	

Auxiliary Systems	
Auxiliary Power Interface	AC480 V / 60 Hz, 3P5W
Thermal Management System	Smart liquid cooling/heating
External Communication Interface	Ethernet connection, Modbus TCP/IP protocol

Mechanical	
Enclosure	20ft. high-cube container
Dimensions (L*W*H)	6058*2438*2896 mm (238.50*95.98*114.02 in)
Weight (Battery Included)	43,000 kg (94,800 lbs)
Enclosure Ingress Rating	IP55 / NEMA 3R
Painting/Coating	RAL9003 / C4 Coating
Seismic Parameter	Zone 4

Safety	
Fire Detection and Alarm	Fire alarm panel, heat and smoke detection, alarm bell and strobe
Explosion Prevention	Combustible gas detector with active ventilation
Uninterrupted Power Reserve	Container level UPS for 2-hr control system backup; dedicated fire safety UPS for 24-hr fire alarm backup
Emergency Stop/Automatic Shut-off	Local and Remote
Fire Suppression Options	Aerosol-based suppression system. Dry pipe sprinkler system.

SolBank 3.0
Circuit Diagram



Notes

1. The unit is rated at 1164.8V~1497.6V for optimized product performance, the maximum voltage range for the battery system is 1060.8V~1497.6V
2. Rated DC Power is measured at the product DC terminal, the Rated DC Power and Initial Storage Capacity is limited to the use of two SolBank 3.0 units connected in parallel
3. Initial Storage Capacity is the usable product capacity at FAT, contact e-STORAGE for capacity at COD per project schedule
4. DC RTE is measured during capacity test at Rated DC Power, refer to the product warranty document for the complete procedure

Canadian Solar SSES (US) Inc. 545 Speedvale Avenue West, Guelph Ontario | Canada N1K1E6, support@csestorage.com

TECHNICAL CHARACTERISTICS

FREEMAQ MULTI PCSM

REFERENCES		FP4200M2	FP4201M2	FP4200M4	FP4201M4
AC	AC Output Power (kVA/kW) @40°C [1]	4200			
	AC Output Power (kVA/kW) @50°C [1]	3900			
	Operating Grid Voltage (kV)	34.5kV ±10%	13.8kV ±10%	34.5kV ±10%	13.8kV ±10%
	Operating Grid Frequency (Hz)	60Hz			
	Current Harmonic Distortion (THDi)	< 3% per IEEE519			
	Power Factor (cos phi) [2]	0.5 leading … 0.5 lagging			
	Reactive Power Compensation	Four quadrant operation			
DC	DC Voltage Range [3]	934V - 1500V			
	Maximum DC Voltage	1500V			
	DC Voltage Ripple	< 3%			
	Max. DC Continuous Current per Input (A)	2295		1148	
	Max. DC Short Circuit Current per Input (kA)	250 kA with a time constant of 3 ms			
	Battery Technology	All type of batteries (BMS required)			
	Number of Separate DC Inputs	2		4	
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η) (preliminary)	97.80% including MV transformer			
	Euroeta (η) (preliminary)	97.51% including MV transformer			
CABINET	Dimensions [WxDxH] (ft)	21.3 x 6.5 x 7.2			
	Dimensions [WxDxH] (m)	6.5 x 2.0 x 2.2			
	Weight (lbs)	30865			
	Weight (kg)	14000			
	Type of Ventilation	Forced air cooling			
ENVIRONMENT	Degree of Protection	NEMA 3R			
	Operating Temperature Range [4]	From -25°C to +60°C, >50°C power derating			
	Operating Relative Humidity Range	From 4% to 100% non-condensing			
	Storage Temperature Range	From -15°C to +40°C			
	Max. Altitude (above sea level) [5]	2000m			
CONTROL INTERFACE	Communication Protocol	Modbus TCP			
	Power Plant Controller	Optional. Third party SCADA systems supported.			
	Keyed ON/OFF Switch	Standard			
PROTECTIONS	Ground Fault Protection	Insulation monitoring device			
	Humidity Control	Active heating			
	General AC Protection & Disconn.	MV switchgear (20 or 25 kA)			
	General DC Protection & Disconn.	DC switch-disconnectors [6]			
	Overvoltage Protection	Type 2 protection for AC and DC (optionally, Type 1+2 for DC side)			
CERTIFICATIONS & STANDARDS	Safety	UL 1741 / CSA 22.2 No.107.1-16			
	Installation	NEC 2020			
	Utility Interconnect [7]	IEEE 1547:2018 / UL 1741 SA & SB			

[1] Values at 1.00·Vac nom and cosφ=1.

Consult Power Electronics for derating curves.

[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.

[3] Consult Power Electronics for derating curves.

[4] Optional available for temperatures down to -35ºC

[5] Consult Power Electronics for altitudes above 1000m.

[6] Battery short circuit disconnection must be done on the battery side.

[7] Consult Power Electronics for other applicable standards / grid codes.

TECHNICAL CHARACTERISTICS

FREEMAQ MULTI PCSM

REFERENCES		FP4105M2	FP4106M2	FP4105M4	FP4106M4
AC	AC Output Power (kVA/kW) @40°C [1]	4105			
	AC Output Power (kVA/kW) @50°C [1]	3810			
	Operating Grid Voltage (kV)	34.5kV ±10%	13.8kV ±10%	34.5kV ±10%	13.8kV ±10%
	Operating Grid Frequency (Hz)	60Hz			
	Current Harmonic Distortion (THDi)	< 3% per IEEE519			
	Power Factor (cos phi) [2]	0.5 leading ... 0.5 lagging			
	Reactive Power Compensation	Four quadrant operation			
DC	DC Voltage Range [3]	913V - 1500V			
	Maximum DC Voltage	1500V			
	DC Voltage Ripple	< 3%			
	Max. DC Continuous Current per Input (A)	2295		1148	
	Max. DC Short Circuit Current per Input (kA)	250 kA with a time constant of 3 ms			
	Battery Technology	All type of batteries (BMS required)			
	Number of Separate DC Inputs	2		4	
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η) (preliminary)	97.76% including MV transformer			
	Euroeta (η) (preliminary)	97.50% including MV transformer			
CABINET	Dimensions [WxDxH] (ft)	21.3 x 6.5 x 7.2			
	Dimensions [WxDxH] (m)	6.5 x 2.0 x 2.2			
	Weight (lbs)	30865			
	Weight (kg)	14000			
	Type of Ventilation	Forced air cooling			
ENVIRONMENT	Degree of Protection	NEMA 3R			
	Operating Temperature Range [4]	From -25°C to +60°C, >50°C power derating			
	Operating Relative Humidity Range	From 4% to 100% non-condensing			
	Storage Temperature Range	From -15°C to +40°C			
	Max. Altitude (above sea level) [5]	2000m			
CONTROL INTERFACE	Communication Protocol	Modbus TCP			
	Power Plant Controller	Optional. Third party SCADA systems supported.			
	Keyed ON/OFF Switch	Standard			
PROTECTIONS	Ground Fault Protection	Insulation monitoring device			
	Humidity Control	Active heating			
	General AC Protection & Disconn.	MV switchgear (20 or 25 kA)			
	General DC Protection & Disconn.	DC switch-disconnectors [6]			
	Overvoltage Protection	Type 2 protection for AC and DC (optionally, Type 1+2 for DC side)			
CERTIFICATIONS & STANDARDS	Safety	UL 1741 / CSA 22.2 No.107.1-16			
	Installation	NEC 2020			
	Utility Interconnect [7]	IEEE 1547:2018 / UL 1741 SA & SB			

[1] Values at 1.00·Vac nom and cosφ=1.

Consult Power Electronics for derating curves.

[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.

[3] Consult Power Electronics for derating curves.

[4] Optional available for temperatures down to -35ºC

[5] Consult Power Electronics for altitudes above 1000m.

[6] Battery short circuit disconnection must be done on the battery side.

[7] Consult Power Electronics for other applicable standards / grid codes.

TECHNICAL CHARACTERISTICS

FREEMAQ MULTI PCSM

REFERENCES		FP4010M2	FP4011M2	FP4010M4	FP4011M4
AC	AC Output Power (kVA/kW) @40°C [1]	4010			
	AC Output Power (kVA/kW) @50°C [1]	3720			
	Operating Grid Voltage (kV)	34.5kV ±10%	13.8kV ±10%	34.5kV ±10%	13.8kV ±10%
	Operating Grid Frequency (Hz)	60Hz			
	Current Harmonic Distortion (THDi)	< 3% per IEEE519			
	Power Factor (cos phi) [2]	0.5 leading … 0.5 lagging			
	Reactive Power Compensation	Four quadrant operation			
DC	DC Voltage Range [3]	891V - 1500V			
	Maximum DC Voltage	1500V			
	DC Voltage Ripple	< 3%			
	Max. DC Continuous Current per Input (A)	2295		1148	
	Max. DC Short Circuit Current per Input (kA)	250 kA with a time constant of 3 ms			
	Battery Technology	All type of batteries (BMS required)			
	Number of Separate DC Inputs	2		4	
EFFICIENCY & AUX. SUPPLY	Efficiency (Max) (η) (preliminary)	97.80% including MV transformer			
	Euroeta (η) (preliminary)	97.51% including MV transformer			
CABINET	Dimensions [WxDxH] (ft)	21.3 x 6.5 x 7.2			
	Dimensions [WxDxH] (m)	6.5 x 2.0 x 2.2			
	Weight (lbs)	30865			
	Weight (kg)	14000			
	Type of Ventilation	Forced air cooling			
ENVIRONMENT	Degree of Protection	NEMA 3R			
	Operating Temperature Range [4]	From -25°C to +60°C, >50°C power derating			
	Operating Relative Humidity Range	From 4% to 100% non-condensing			
	Storage Temperature Range	From -15°C to +40°C			
	Max. Altitude (above sea level) [5]	2000m			
CONTROL INTERFACE	Communication Protocol	Modbus TCP			
	Power Plant Controller	Optional. Third party SCADA systems supported.			
	Keyed ON/OFF Switch	Standard			
PROTECTIONS	Ground Fault Protection	Insulation monitoring device			
	Humidity Control	Active heating			
	General AC Protection & Disconn.	MV switchgear (20 or 25 kA)			
	General DC Protection & Disconn.	DC switch-disconnectors [6]			
	Overvoltage Protection	Type 2 protection for AC and DC (optionally, Type 1+2 for DC side)			
CERTIFICATIONS & STANDARDS	Safety	UL 1741 / CSA 22.2 No.107.1-16			
	Installation	NEC 2020			
	Utility Interconnect [7]	IEEE 1547:2018 / UL 1741 SA & SB			

[1] Values at 1.00·Vac nom and cosφ=1.

Consult Power Electronics for derating curves.

[2] Consult P-Q charts available: $Q(kVAr)=\sqrt{(S(kVA)^2-P(kW)^2)}$.

[3] Consult Power Electronics for derating curves.

[4] Optional available for temperatures down to -35ºC

[5] Consult Power Electronics for altitudes above 1000m.

[6] Battery short circuit disconnection must be done on the battery side.

[7] Consult Power Electronics for other applicable standards / grid codes.

Attachment B

Safety data sheet

according to Regulation (EC) No. 1907/2006 (REACH), amended by 2020/878/EU

Ethylene glycol ≥99 %, for synthesis

article number: **9516**
Version: **7.0 en**
Replaces version of: 2024-04-08
Version: (6)

date of compilation: 2015-08-27
Revision: 2024-09-18

SECTION 1: Identification of the substance/mixture and of the company/undertaking

1.1 Product identifier

Identification of the substance	**Ethylene glycol** ≥99 %, for synthesis
Article number	9516
Registration number (REACH)	01-2119456816-28-xxxx
Index number in CLP Annex VI	603-027-00-1
EC number	203-473-3
CAS number	107-21-1
Alternative name(s)	Ethanediol

1.2 Relevant identified uses of the substance or mixture and uses advised against

Relevant identified uses:	Laboratory chemical Laboratory and analytical use Formulation [mixing] of preparations and/or re-packaging (excluding alloys) Industrial uses Professional uses
Uses advised against:	Do not use for products which come into contact with foodstuffs. Do not use for private purposes (household). Food, drink and animal feeding-stuffs.

1.3 Details of the supplier of the safety data sheet

Carl Roth GmbH + Co. KG
Schoemperlenstr. 3-5
D-76185 Karlsruhe
Germany

Telephone:+49 (0) 721 - 56 06 0
Telefax: +49 (0) 721 - 56 06 149
e-mail: sicherheit@carlroth.de
Website: www.carlroth.de

Competent person responsible for the safety data sheet:	Department Health, Safety and Environment
e-mail (competent person):	**sicherheit@carlroth.de**

1.4 Emergency telephone number

Name	Street	Postal code/city	Telephone	Website
National Poisons Information Centre Beaumont Hospital	Beaumont Road	Dublin 9	+353 1 809 2166	https://www.poisons.ie/

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 (CLP)

Section	Hazard class	Cat-egory	Hazard class and category	Hazard statement
3.1O	Acute toxicity (oral)	4	Acute Tox. 4	H302
3.9	Specific target organ toxicity - repeated exposure	2	STOT RE 2	H373

For full text of abbreviations: see SECTION 16

The most important adverse physicochemical, human health and environmental effects
Delayed or immediate effects can be expected after short or long-term exposure.

2.2 Label elements

Labelling according to Regulation (EC) No 1272/2008 (CLP)

Signal word **Warning**

Pictograms

GHS07, GHS08

Hazard statements

H302	Harmful if swallowed
H373	May cause damage to organs (kidney) through prolonged or repeated exposure (if swallowed)

Precautionary statements

Precautionary statements - prevention

P260	Do not breathe mist/vapours
P270	Do not eat, drink or smoke when using this product

Precautionary statements - response

P301+P312	IF SWALLOWED: Call a POISON CENTER or doctor if you feel unwell

Labelling of packages where the contents do not exceed 125 ml
Signal word: **Warning**
Hazard pictogram(s):

Labelling of packages where the contents do not exceed 10 ml
Signal word: Not required
Hazard pictogram(s):

Hazard statements:	Not required
Precautionary statements:	Not required

2.3 Other hazards

Results of PBT and vPvB assessment
According to the results of its assessment, this substance is not a PBT or a vPvB.

Endocrine disrupting properties
Does not contain an endocrine disruptor (ED) at a concentration of ≥ 0,1%.

SECTION 3: Composition/information on ingredients

3.1 Substances

Name of substance	Ethylene glycol
Molecular formula	$C_2H_6O_2$
Molar mass	62,07 $^{g}/_{mol}$
REACH Reg. No	01-2119456816-28-xxxx
CAS No	107-21-1
EC No	203-473-3
Index No	603-027-00-1

Substance, Specific Conc. Limits, M-factors, ATE

Specific Conc. Limits	M-Factors	ATE	Exposure route
-	-	500 $^{mg}/_{kg}$	oral

SECTION 4: First aid measures

4.1 Description of first aid measures

General notes
Take off contaminated clothing.

Following inhalation
Provide fresh air. In all cases of doubt, or when symptoms persist, seek medical advice.

Following skin contact
Rinse skin with water/shower. In all cases of doubt, or when symptoms persist, seek medical advice.

Following eye contact
Rinse cautiously with water for several minutes. In all cases of doubt, or when symptoms persist, seek medical advice.

Following ingestion
Rinse mouth with water (only if the person is conscious). Call a doctor.

4.2 Most important symptoms and effects, both acute and delayed
Fatigue, Vertigo, Agitation, Diarrhoea, Vomiting, Nausea, Unconsciousness

4.3 Indication of any immediate medical attention and special treatment needed
none

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media

co-ordinate firefighting measures to the fire surroundings!
water spray, alcohol resistant foam, dry extinguishing powder, BC-powder, carbon dioxide (CO_2)

Unsuitable extinguishing media

water jet

5.2 Special hazards arising from the substance or mixture

Combustible. Vapours are heavier than air, spread along floors and form explosive mixtures with air.

Hazardous combustion products

In case of fire may be liberated: Carbon monoxide (CO), Carbon dioxide (CO_2)

5.3 Advice for firefighters

In case of fire and/or explosion do not breathe fumes. Fight fire with normal precautions from a reasonable distance. Wear self-contained breathing apparatus.

SECTION 6: Accidental release measures

6.1 Personal precautions, protective equipment and emergency procedures

For non-emergency personnel

Avoid contact with skin, eyes and clothes. Do not breathe vapour/spray.

6.2 Environmental precautions

Keep away from drains, surface and ground water. Retain contaminated washing water and dispose of it.

6.3 Methods and material for containment and cleaning up

Advice on how to contain a spill

Covering of drains.

Advice on how to clean up a spill

Absorb with liquid-binding material (sand, diatomaceous earth, acid- or universal binding agents).

Other information relating to spills and releases

Place in appropriate containers for disposal.

6.4 Reference to other sections

Hazardous combustion products: see section 5. Personal protective equipment: see section 8. Incompatible materials: see section 10. Disposal considerations: see section 13.

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Provision of sufficient ventilation.

Advice on general occupational hygiene

Wash hands before breaks and after work. Keep away from food, drink and animal feedingstuffs.

7.2 Conditions for safe storage, including any incompatibilities

Keep container tightly closed. Store in a dry place. Hygroscopic.

Incompatible substances or mixtures

Observe hints for combined storage. Incompatible materials: see section 10.

Protect against external exposure, such as

humidity

Consideration of other advice:

Specific designs for storage rooms or vessels

Recommended storage temperature: 15 – 25 °C

7.3 Specific end use(s)

No information available.

SECTION 8: Exposure controls/personal protection

8.1 Control parameters

National limit values

Occupational exposure limit values (Workplace Exposure Limits)

Country	Name of agent	CAS No	Identifier	TWA [ppm]	TWA [mg/m³]	STEL [ppm]	STEL [mg/m³]	Ceiling-C [ppm]	Ceiling-C [mg/m³]	Notation	Source
EU	ethylene glycol	107-21-1	IOELV	20	52	40	104			H	2000/39/EC
IE	ethane-1,2-diol	107-21-1	OELV	20	40	52	104			H	S.I. No. 619 of 2001

Notation

Ceiling-C	Ceiling value is a limit value above which exposure should not occur
H	Absorbed through the skin
STEL	Short-term exposure limit: a limit value above which exposure should not occur and which is related to a 15-minute period (unless otherwise specified)
TWA	Time-weighted average (long-term exposure limit): measured or calculated in relation to a reference period of 8 hours time-weighted average (unless otherwise specified)

Human health values

Relevant DNELs and other threshold levels

Endpoint	Threshold level	Protection goal, route of exposure	Used in	Exposure time
DNEL	35 mg/m³	human, inhalatory	worker (industry)	chronic - local effects
DNEL	106 mg/kg bw/day	human, dermal	worker (industry)	chronic - systemic effects

Environmental values

Relevant PNECs and other threshold levels

End-point	Threshold level	Organism	Environmental compartment	Exposure time
PNEC	10 mg/l	aquatic organisms	freshwater	short-term (single instance)
PNEC	1 mg/l	aquatic organisms	marine water	short-term (single instance)

Relevant PNECs and other threshold levels				
End-point	**Threshold level**	**Organism**	**Environmental compartment**	**Exposure time**
PNEC	199,5 $^{mg}/_{l}$	aquatic organisms	sewage treatment plant (STP)	short-term (single instance)
PNEC	37 $^{mg}/_{kg}$	aquatic organisms	freshwater sediment	short-term (single instance)
PNEC	3,7 $^{mg}/_{kg}$	aquatic organisms	marine sediment	short-term (single instance)
PNEC	1,53 $^{mg}/_{kg}$	terrestrial organisms	soil	short-term (single instance)

8.2 Exposure controls

Individual protection measures (personal protective equipment)

Eye/face protection

Use safety goggle with side protection.

Skin protection

• hand protection

Wear suitable gloves. Chemical protection gloves are suitable, which are tested according to EN 374. For special purposes, it is recommended to check the resistance to chemicals of the protective gloves mentioned above together with the supplier of these gloves. The times are approximate values from measurements at 22 ° C and permanent contact. Increased temperatures due to heated substances, body heat etc. and a reduction of the effective layer thickness by stretching can lead to a considerable reduction of the breakthrough time. If in doubt, contact manufacturer. At an approx. 1.5 times larger / smaller layer thickness, the respective breakthrough time is doubled / halved. The data apply only to the pure substance. When transferred to substance mixtures, they may only be considered as a guide.

• type of material

NBR (Nitrile rubber)

• material thickness

>0,3 mm

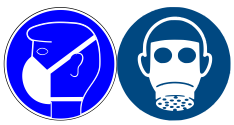
• breakthrough times of the glove material

>480 minutes (permeation: level 6)

• other protection measures

Take recovery periods for skin regeneration. Preventive skin protection (barrier creams/ointments) is recommended.

Respiratory protection



Respiratory protection necessary at: Aerosol or mist formation. Type: A (against organic gases and vapours with a boiling point of > 65 °C , colour code: Brown).

Environmental exposure controls

Keep away from drains, surface and ground water.

SECTION 9: Physical and chemical properties

9.1 Information on basic physical and chemical properties

Physical state	liquid
Colour	colourless - light yellow
Odour	odourless
Melting point/freezing point	-14 – -12 °C at 1.013 hPa
Boiling point or initial boiling point and boiling range	197 – 198 °C at 1.013 hPa
Flammability	this material is combustible, but will not ignite readily
Lower and upper explosion limit	3,2 vol% (LEL) - 43 vol% (UEL)
Flash point	111 °C at 1.013 hPa (ECHA)
Auto-ignition temperature	412 °C at 1.013 hPa (ECHA)
Decomposition temperature	not relevant
pH (value)	6 – 7,5 (in aqueous solution: 100 $^{g}/_{l}$, 20 °C)
Kinematic viscosity	not determined
Dynamic viscosity	16 – 18 mPa s at 25 °C
<u>Solubility(ies)</u>	
Water solubility	1.000 $^{g}/_{l}$ at 20 °C (ECHA)
<u>Partition coefficient</u>	
Partition coefficient n-octanol/water (log value):	-1,36 (ECHA)
Soil organic carbon/water (log KOC)	0 (ECHA)
Vapour pressure	0,12 hPa at 25 °C
<u>Density and/or relative density</u>	
Density	1,11 $^{g}/_{cm^3}$ at 20 °C (ECHA)
Relative vapour density	2,14 (air = 1)
Particle characteristics	not relevant (liquid)
<u>Other safety parameters</u>	
Oxidising properties	none

9.2 Other information

Information with regard to physical hazard classes:	hazard classes acc. to GHS (physical hazards): not relevant
Other safety characteristics:	

Temperature class (EU, acc. to ATEX)	T2 Maximum permissible surface temperature on the equipment: 300°C

SECTION 10: Stability and reactivity

10.1 Reactivity

This material is not reactive under normal ambient conditions.

If heated

Vapours may form explosive mixtures with air.

10.2 Chemical stability

The material is stable under normal ambient and anticipated storage and handling conditions of temperature and pressure.

10.3 Possibility of hazardous reactions

Exothermic reaction with: Sulphuric acid, Alkali hydroxide (caustic alkali), Aluminium, Nitric acid,
Risk of ignition: Chlorates, Permanganates, Peroxides, strong oxidiser

10.4 Conditions to avoid

Protect from moisture. Keep away from heat.

10.5 Incompatible materials

aluminium, zinc

10.6 Hazardous decomposition products

Hazardous combustion products: see section 5.

SECTION 11: Toxicological information

11.1 Information on hazard classes as defined in Regulation (EC) No 1272/2008

Classification according to GHS (1272/2008/EC, CLP)

Acute toxicity

Harmful if swallowed.

Acute toxicity					
Exposure route	**Endpoint**	**Value**	**Species**	**Method**	**Source**
dermal	LD50	>3.500 $^{mg}/_{kg}$	mouse		ECHA
oral	LD50	4.700 $^{mg}/_{kg}$	rat		TOXNET

Skin corrosion/irritation

Shall not be classified as corrosive/irritant to skin.

Serious eye damage/eye irritation

Shall not be classified as seriously damaging to the eye or eye irritant.

Respiratory or skin sensitisation

Shall not be classified as a respiratory or skin sensitiser.

Germ cell mutagenicity

Shall not be classified as germ cell mutagenic.

Carcinogenicity

Shall not be classified as carcinogenic.

Reproductive toxicity

Shall not be classified as a reproductive toxicant.

Specific target organ toxicity - single exposure
Shall not be classified as a specific target organ toxicant (single exposure).

Specific target organ toxicity - repeated exposure
May cause damage to organs (kidney) through prolonged or repeated exposure (if swallowed).

Hazard category	Target organ	Exposure route
2	kidney	if swallowed

Aspiration hazard
Shall not be classified as presenting an aspiration hazard.

Symptoms related to the physical, chemical and toxicological characteristics

- **If swallowed**
diarrhoea, vomiting, nausea, Liver and kidney damage
- **If in eyes**
essentially non-irritating
- **If inhaled**
Data are not available.
- **If on skin**
essentially non-irritating
- **Other information**
Other adverse effects: Loss of righting reflex, and ataxia, Unconsciousness, Drowsiness, Agitation

11.2 Endocrine disrupting properties
Does not contain an endocrine disruptor (ED) at a concentration of ≥ 0,1%.

11.3 Information on other hazards
There is no additional information.

SECTION 12: Ecological information

12.1 Toxicity
Shall not be classified as hazardous to the aquatic environment.

Aquatic toxicity (acute)

Endpoint	Value	Species	Source	Exposure time
LC50	>72.860 $^{mg}/_{l}$	fish	ECHA	96 h
EC50	>100 $^{mg}/_{l}$	daphnia magna	ECHA	48 h
ErC50	<13.000 $^{mg}/_{l}$	algae	ECHA	96 h

Aquatic toxicity (chronic)

Endpoint	Value	Species	Source	Exposure time
LC50	>1.500 $^{mg}/_{l}$	fish	ECHA	28 d
EC50	>15.000 $^{mg}/_{l}$	aquatic invertebrates	ECHA	21 d
NOEC	≥1.000 $^{mg}/_{l}$	aquatic invertebrates	ECHA	23 d

12.2 Persistence and degradability

Theoretical Oxygen Demand: 1,29 $^{g}/_{g}$
Theoretical Carbon Dioxide: 1,418 $^{mg}/_{mg}$

Biodegradation

The substance is readily biodegradable.

Process of degradability		
Process	**Degradation rate**	**Time**
biotic/abiotic	83 – 96 %	14 d
DOC removal	90 – 100 %	10 d

12.3 Bioaccumulative potential

Does not significantly accumulate in organisms.

n-octanol/water (log KOW)	-1,36 (ECHA)

12.4 Mobility in soil

Henry's law constant	0,013 $^{Pa\ m^3}/_{mol}$ at 25 °C (ECHA)
The Organic Carbon normalised adsorption coefficient	0 (ECHA)

12.5 Results of PBT and vPvB assessment

Data are not available.

12.6 Endocrine disrupting properties

Does not contain an endocrine disruptor (ED) at a concentration of ≥ 0,1%.

12.7 Other adverse effects

Data are not available.

SECTION 13: Disposal considerations

13.1 Waste treatment methods

This material and its container must be disposed of as hazardous waste. Dispose of contents/container in accordance with local/regional/national/international regulations.

Sewage disposal-relevant information

Do not empty into drains.

Waste treatment of containers/packagings

Handle contaminated packages in the same way as the substance itself. Completely emptied packages can be recycled.

13.2 Relevant provisions relating to waste

The allocation of waste identity numbers/waste descriptions must be carried out according to the EEC, specific to the industry and process.

Properties of waste which render it hazardous
HP 5 specific target organ toxicity (STOT)/aspiration toxicity
HP 6 acute toxicity

13.3 Remarks

Waste shall be separated into the categories that can be handled separately by the local or national waste management facilities. Please consider the relevant national or regional provisions. Non-contaminated packages may be recycled.

SECTION 14: Transport information

14.1	**UN number or ID number**	not subject to transport regulations
14.2	**UN proper shipping name**	not assigned
14.3	**Transport hazard class(es)**	none
14.4	**Packing group**	not assigned
14.5	**Environmental hazards**	non-environmentally hazardous acc. to the dangerous goods regulations

14.6 Special precautions for user

There is no additional information.

14.7 Maritime transport in bulk according to IMO instruments

The cargo is not intended to be carried in bulk.

14.8 Information for each of the UN Model Regulations

International Maritime Dangerous Goods Code (IMDG) - Additional information

Not subject to IMDG.

International Civil Aviation Organization (ICAO-IATA/DGR) - Additional information

Not subject to ICAO-IATA.

SECTION 15: Regulatory information

15.1 Safety, health and environmental regulations/legislation specific for the substance or mixture

Relevant provisions of the European Union (EU)

Restrictions according to REACH, Annex XVII

Dangerous substances with restrictions (REACH, Annex XVII)

Name of substance	Name acc. to inventory	CAS No	Restriction	No
Ethylene glycol	this product meets the criteria for classification in accordance with Regulation No 1272/2008/EC		R3	3

Legend

R3 1. Shall not be used in:
- ornamental articles intended to produce light or colour effects by means of different phases, for example in ornamental lamps and ashtrays,
- tricks and jokes,
- games for one or more participants, or any article intended to be used as such, even with ornamental aspects,
2. Articles not complying with paragraph 1 shall not be placed on the market.
3. Shall not be placed on the market if they contain a colouring agent, unless required for fiscal reasons, or perfume, or both, if they:
— can be used as fuel in decorative oil lamps for supply to the general public, and
— present an aspiration hazard and are labelled with H304.
4. Decorative oil lamps for supply to the general public shall not be placed on the market unless they conform to the European Standard on Decorative oil lamps (EN 14059) adopted by the European Committee for Standardisation (CEN).
5. Without prejudice to the implementation of other Union provisions relating to the classification, labelling and packaging of substances and mixtures, suppliers shall ensure, before the placing on the market, that the following requirements are met:
(a) lamp oils, labelled with H304, intended for supply to the general public are visibly, legibly and indelibly marked as follows: “Keep lamps filled with this liquid out of the reach of children”; and, by 1 December 2010, “Just a sip of lamp oil – or even sucking the wick of lamps – may lead to life-threatening lung damage”;

Legend

(b) grill lighter fluids, labelled with H304, intended for supply to the general public are legibly and indelibly marked by 1 December 2010 as follows: 'Just a sip of grill lighter fluid may lead to life threatening lung damage';
(c) lamps oils and grill lighters, labelled with H304, intended for supply to the general public are packaged in black opaque containers not exceeding 1 litre by 1 December 2010.';

List of substances subject to authorisation (REACH, Annex XIV)/SVHC - candidate list

not listed

Seveso Directive

2012/18/EU (Seveso III)			
No	**Dangerous substance/hazard categories**	**Qualifying quantity (tonnes) for the application of lower and upper-tier requirements**	**Notes**
	not assigned		

Deco-Paint Directive

VOC content	100 %
VOC content	1.110 $^{g}/_{l}$

Industrial Emissions Directive (IED)

VOC content	100 %
VOC content	1.110 $^{g}/_{l}$

Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment (RoHS)

not listed

Regulation concerning the establishment of a European Pollutant Release and Transfer Register (PRTR)

not listed

Water Framework Directive (WFD)

not listed

Regulation on the marketing and use of explosives precursors

not listed

Regulation on drug precursors

not listed

Regulation on substances that deplete the ozone layer (ODS)

not listed

Regulation concerning the export and import of hazardous chemicals (PIC)

not listed

Regulation on persistent organic pollutants (POP)

not listed

Other information

Directive 94/33/EC on the protection of young people at work. Observe employment restrictions under the Maternity Protection Directive (92/85/EEC) for expectant or nursing mothers.

National inventories

Country	Inventory	Status
AU	AIIC	substance is listed
CA	DSL	substance is listed
CN	IECSC	substance is listed
EU	ECSI	substance is listed
EU	REACH Reg.	substance is listed
JP	CSCL-ENCS	substance is listed
KR	KECI	substance is listed
MX	INSQ	substance is listed
NZ	NZIoC	substance is listed
PH	PICCS	substance is listed
TR	CICR	substance is listed
TW	TCSI	substance is listed
US	TSCA	substance is listed (ACTIVE)
VN	NCI	substance is listed

Legend

AIIC	Australian Inventory of Industrial Chemicals
CICR	Chemical Inventory and Control Regulation
CSCL-ENCS	List of Existing and New Chemical Substances (CSCL-ENCS)
DSL	Domestic Substances List (DSL)
ECSI	EC Substance Inventory (EINECS, ELINCS, NLP)
IECSC	Inventory of Existing Chemical Substances Produced or Imported in China
INSQ	National Inventory of Chemical Substances
KECI	Korea Existing Chemicals Inventory
NCI	National Chemical Inventory
NZIoC	New Zealand Inventory of Chemicals
PICCS	Philippine Inventory of Chemicals and Chemical Substances (PICCS)
REACH Reg.	REACH registered substances
TCSI	Taiwan Chemical Substance Inventory
TSCA	Toxic Substance Control Act

15.2 Chemical safety assessment

According to REACH, Article 14 (1) a chemical safety assessment has been carried out for this substance or components of this mixture when the substance has been registered in quantities of 10 tonnes or more per year per registrant.

SECTION 16: Other information

Indication of changes (revised safety data sheet)

Section	Former entry (text/value)	Actual entry (text/value)	Safety-relevant
2.2		Labelling of packages where the contents do not exceed 125 ml: change in the listing (table)	yes
2.2		Labelling of packages where the contents do not exceed 125 ml: change in the listing (table)	yes
2.2		Hazard pictogram(s):	yes
2.2		Hazard pictogram(s):: change in the listing (table)	yes
2.2		Labelling of packages where the contents do	yes

Section	Former entry (text/value)	Actual entry (text/value)	Safety-relev-ant
		not exceed 10 ml	
2.2		Signal word: Not required	yes
2.2		Hazard pictogram(s):	yes
2.2		Hazard pictogram(s):: change in the listing (table)	yes
2.2		Hazard statements: Not required	yes
2.2		Precautionary statements: Not required	yes

Abbreviations and acronyms

Abbr.	Descriptions of used abbreviations
2000/39/EC	Commission Directive establishing a first list of indicative occupational exposure limit values in implementation of Council Directive 98/24/EC
ADR	Accord relatif au transport international des marchandises dangereuses par route (Agreement concerning the International Carriage of Dangerous Goods by Road)
ATE	Acute Toxicity Estimate
CAS	Chemical Abstracts Service (service that maintains the most comprehensive list of chemical substances)
Ceiling-C	Ceiling value
CLP	Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures
DGR	Dangerous Goods Regulations (see IATA/DGR)
DNEL	Derived No-Effect Level
EC50	Effective Concentration 50 %. The EC50 corresponds to the concentration of a tested substance causing 50 % changes in response (e.g. on growth) during a specified time interval
EC No	The EC Inventory (EINECS, ELINCS and the NLP-list) is the source for the seven-digit EC number, an identifier of substances commercially available within the EU (European Union)
ED	Endocrine disruptor
EINECS	European Inventory of Existing Commercial Chemical Substances
ELINCS	European List of Notified Chemical Substances
ErC50	≡ EC50: in this method, that concentration of test substance which results in a 50 % reduction in either growth (EbC50) or growth rate (ErC50) relative to the control
GHS	"Globally Harmonized System of Classification and Labelling of Chemicals" developed by the United Nations
IATA	International Air Transport Association
IATA/DGR	Dangerous Goods Regulations (DGR) for the air transport (IATA)
ICAO	International Civil Aviation Organization
IMDG	International Maritime Dangerous Goods Code
index No	The Index number is the identification code given to the substance in Part 3 of Annex VI to Regulation (EC) No 1272/2008
IOELV	Indicative occupational exposure limit value
LC50	Lethal Concentration 50%: the LC50 corresponds to the concentration of a tested substance causing 50 % lethality during a specified time interval
LD50	Lethal Dose 50 %: the LD50 corresponds to the dose of a tested substance causing 50 % lethality during a

Abbr.	Descriptions of used abbreviations
	specified time interval
LEL	Lower explosion limit (LEL)
NLP	No-Longer Polymer
NOEC	No Observed Effect Concentration
PBT	Persistent, Bioaccumulative and Toxic
PNEC	Predicted No-Effect Concentration
ppm	Parts per million
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals
RID	Règlement concernant le transport International ferroviaire des marchandises Dangereuses (Regulations concerning the International carriage of Dangerous goods by Rail)
S.I. No. 619 of 2001	Safety, Health and Welfare at Work (Chemical Agents) Regulations 2001
STEL	Short-term exposure limit
SVHC	Substance of Very High Concern
TWA	Time-weighted average
UEL	Upper explosion limit (UEL)
VOC	Volatile Organic Compounds
vPvB	Very Persistent and very Bioaccumulative

Key literature references and sources for data

Regulation (EC) No 1272/2008 on classification, labelling and packaging of substances and mixtures. Regulation (EC) No. 1907/2006 (REACH), amended by 2020/878/EU.
Agreement concerning the International Carriage of Dangerous Goods by Road (ADR). Regulations concerning the International Carriage of Dangerous Goods by Rail (RID). International Maritime Dangerous Goods Code (IMDG). Dangerous Goods Regulations (DGR) for the air transport (IATA).

List of relevant phrases (code and full text as stated in section 2 and 3)

Code	Text
H302	Harmful if swallowed.
H373	May cause damage to organs (kidney) through prolonged or repeated exposure (if swallowed).

Disclaimer

This information is based upon the present state of our knowledge. This SDS has been compiled and is solely intended for this product.

Discover®
Innovative Battery Solutions

Safety Data Sheet (SDS)

Revision date: December 15, 2021

SECTION 1: Identification of the substance / mixture and the company / undertaking

1.1 Product Identifier

Lithium-ion cells and battery packs, $LiFePO_4$

Product brand: Discover

Product Model	Marketing Name
12-48-6650	12-48-6650
42-48-6650	42-48-6650
12-36-6700	12-36-6700
14-24-2800	14-24-2800
44-24-2800	44-24-2800
15-24-1000	15-24-1000
15-36-1000	15-36-1000
900-0041	14-48-3000 / 44-48-3000
900-0042	14-36-3000
900-0043	14-24-3000
900-0044	14-12-3000
590-0080	n/a
590-0086	n/a
590-0090	n/a
590-0097	n/a
IFR 26650P	n/a
IFR 32650	n/a

Product Model	Marketing Name
900-0046	DLB-G24-12V
900-0047	DLB-G24-24V
900-0048	DLB-G24-36V
900-0049	DLB-GC12-12V
900-0050	DLB-GC12-24V
900-0051	DLP-GC2-12V
900-0052	DLP-GC2-24V
900-0053	DLP-GC2-36V
900-0054	DLP-GC2-48V
900-0065	46-48-1540
900-0066	46-24-1540
GSP34135214F	n/a
2770180E_30Ah_LFP	n/a

Other means of identification:

Discover Energy Advanced Energy Systems (AES)
Discover LITHIUM BLUE Premium Series Lithium Battery
Discover LITHIUM PROFESSIONAL Series Lithium Battery
Discover HELIOS Energy Storage Lithium Battery
Discover Energy lithium / lithium ion
Discover Energy cell / module / battery / pack / system
Battery module / battery / pack / system

1.2 Relevant identified uses of the substance or mixture and uses advised against

Recommended Use: Electrochemical energy storage - industrial use
Uses advised against: Not applicable

1.3 Details of the supplier of the safety data sheet

Company: Discover Energy Corp.
Address: #4 Crestwood Place, Richmond, BC V6V 2E9 Canada
Telephone: +1 (778) 776 3288 Website: www.discoverbattery.com

1.4 Emergency telephone number

Emergency phone: 1-800-535-5053 (Account# 84774)

SECTION 2: Hazards identification

2.1 Classification of the substance or mixture

Classification according to Regulation (EC) No 1272/2008 [CLP]

This product is considered as a manufactured article, and not classified as hazardous according to EC 1272/2008.

Classification according to Directive 67/548/EEC

This product is not classified as hazardous according to Directive 67/548/EEC.

Classification according to Directive 1999/45/EC

This product is not classified as hazardous according to Directive 1999/45/EC.

2.2 Label elements

Symbols / Pictograms	No pictogram is used
Signal word	No signal word is used
Hazard statements	Not classified
Precautionary statements	Not classified

2.3 Other hazards

Primary route(s) to exposure

This product is safe with normal use. Exposure to the ingredients contained within and/or their combustion products could be harmful. Risk of exposure occurs only if the battery is mechanically, thermally, or electrically abused and the enclosure is ruptured. If this occurs, exposure to electrolyte can occur by inhalation, ingestion, eye contact, and skin contact. The battery should not be opened or burned.

Inhalation

Inhalation of material from a sealed battery/cell is not an expected route of exposure. Vapors or mists from a ruptured battery/cell may cause respiratory irritation.

Ingestion

Swallowing of material from a sealed battery/cell is not an expected route of exposure. Swallowing the contents of a ruptured cell may cause serious chemical burns of the mouth, esophagus, and gastrointestinal tract.

Skin

Contact between the skin and battery will not cause harm. Contact with the contents of a ruptured cell/battery can cause severe irritation or burns to the skin.

Eye

Contact between the eye and battery will not cause harm. Contact with the contents of a ruptured cell/battery can cause severe irritation or burns to the eye.

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SECTION 3: Composition/information on ingredients

3.1 Substances

Product is a manufactured article. Exposure to interior of article is not expected with normal use.

3.2 Mixture

Product is a manufactured article. Exposure to hazardous ingredients is not expected with normal use.

Composition for Li-ion Cell (Model: IFR32650) used inside product.

Chemical Name	EC No	CAS No.	Weight (%)	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Lithium Iron Phosphate	---	15365-14-7	27.04	Not classified
Graphite (C)	231-955-3	7782-42-5	12.78	Carc. 1A, H350 Carc. 2, H351 STOT RE 1, H372 Comb. Dust
Aluminium (Al)	231-072-3	7429-90-5	6.44	Flam. Sol. 1 (H228) Water-react. 2 (H261)
Copper (Cu)	231-159-6	7440-50-8	9.22	Acute Tox. 4 (Oral), H302 Comb. Dust
Iron	231-096-4	7439-89-6	23.52	Comb. Dust
Nickel (Ni)	231-111-4	7440-02-0	1.18	Skin Sens. 1; Carc. 2; STOT RE 1; Aquatic Chronic 3; H317, H351, H372, H412
Polyethylene $(C_2H_4)n)$	---	9002-88-4	4.37	Comb. Dust
Lithium, Hexafluorphosphate ($LiPF_6$)	244-334-7	21324-40-3	2.01	Acute Tox. 3; Skin Corr. 1A; STOT RE 1; H301, H314, H372
Organic Solvent	---	---	13.44	Not classified

Composition for Li-ion Cell (Model: IFR26650P) used inside product.

Chemical Name	EC No	CAS No.	Weight (%)	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Lithium Iron Phosphate	---	15365-14-7	27.04	Not classified
Graphite (C)	231-955-3	7782-42-5	12.78	Carc. 1A, H350 Carc. 2, H351 STOT RE 1, H372 Comb. Dust
Aluminium (Al)	231-072-3	7429-90-5	6.44	Flam. Sol. 1 (H228) Water-react. 2 (H261)
Copper (Cu)	231-159-6	7440-50-8	9.22	Acute Tox. 4 (Oral), H302 Comb. Dust
Iron	231-096-4	7439-89-6	23.52	Comb. Dust
Polyethylene $(C_2H_4)n)$	---	9002-88-4	4.37	Comb. Dust
Organic Solvent	---	---	13.44	Not classified

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Composition for Li-ion Cell (Model: 2770180E_30Ah_LFP) used inside product.

Chemical Name	EC No	CAS No.	Weight (%)	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Lithium Iron Phosphate	---	15365-14-7	28-32	Not classified
Graphite (C)	231-955-3	7782-42-5	13-17	Carc. 1A, H350 Carc. 2, H351 STOT RE 1, H372 Comb. Dust
Aluminium (Al)	231-072-3	7429-90-5	15-19	Flam. Sol. 1 (H228) Water-react. 2 (H261)
Copper (Cu)	231-159-6	7440-50-8	16-20	Acute Tox. 4 (Oral), H302 Comb. Dust
Iron	---	---	---	---
Polyethylene $(C_2H_4)n)$	---	---	---	---
Organic Solvent	---	---	15-18	Not classified

Composition for Li-ion Cell (Model: GSP34135214F) used inside product.

Chemical Name	EC No	CAS No.	Weight (%)	Classification according to Regulation (EC) No. 1272/2008 [CLP]
Lithium Iron Phosphate	---	15365-14-7	23	Not classified
Graphite (C)	231-955-3	7782-42-5	11.5	Carc. 1A, H350 Carc. 2, H351 STOT RE 1, H372 Comb. Dust
Aluminium (Al)	231-072-3	7429-90-5	5.5	Flam. Sol. 1 (H228) Water-react. 2 (H261)
Copper (Cu)	231-159-6	7440-50-8	6.7	Acute Tox. 4 (Oral), H302 Comb. Dust
Iron	---	---	---	---
Polyethylene $(C_2H_4)n)$	---	9002-88-4	2	Comb. Dust
Organic Solvent	---	---	13.2	Not classified

Weight of metallic lithium per cell: 0g. There is no metallic lithium in the lithium polymer battery.

These chemicals are contained in a sealed can, inside a sealed container. Risk of exposure only occurs if battery is mechanically, thermally or electrically abused.

SECTION 4: First aid measures

4.1 Description of first aid measures

General advice

In all cases of doubt, or when symptoms persist, seek medical attention. Contact of electrolyte and extruded lithium with skin and eyes should be avoided.

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Eyes
Not an expected route of exposure. Following eye contact, cautiously rinse affected eye with clean lukewarm water for at least 30 minutes. Remove contact lenses, if present and easy to do. If eye irritation persists, seek medical attention.

Skin
Not expected to present as skin hazard under anticipated conditions of normal use. Following skin contact, immediately remove contaminated clothing and wash skin with copious amounts of soap and water. If irritation or pain persists, seek medical attention.

Ingestion
Following ingestion, rinse out mouth with water. DO NOT INDUCE VOMITING. Seek immediate medical attention.

Inhalation
Not an expected route of exposure. If inhaled electrolyte, remove victim to fresh air and remove source of contamination from area. Keep at rest in a position comfortable for breathing. If experiencing respiratory symptoms, seek medical attention.

4.2 Most important symptoms and effects, both acute and delayed

Acute effects
Direct contact of internal electrolyte gel with eyes may cause severe burns or blindness
Direct contact of internal electrolyte gel with the skin may cause skin irritation or damaging burns.
Vapor or mist can irritate the eyes, mucous membranes and respiratory tract. Exposure can cause nausea, dizziness and headache.

Chronic/delayed effects
Overexposure to the internal electrolyte gel may cause reproductive disorder(s) based on tests with laboratory animals. Target organs affected could be kidneys, central nervous system, eyes, and male reproductive system. Overexposure may cause cancer. Target organs are the brain, intestine, mammary gland, haematopoietic system and kidneys.

4.3 Indication of any immediate medical attention and special treatment needed

Treat symptomatically.

SECTION 5: Firefighting measures

5.1 Extinguishing media

Suitable extinguishing media
Water, dry chemical powder, carbon dioxide (CO2) and foam are most effective to extinguish a battery fire.

For small fires use only sand, dry chemical powder, CO2 or regular foam. Continuously apply media until fire is extinguished.

For large fires, use copious quantities of water spray. Continuously apply media until fire is extinguished. Large fires should only be extinguished by trained fire fighters.

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Unsuitable extinguishing media
Do not use small quantities of water. If water spray is used, it must be continually applied until fire is extinguished.

5.2 Special hazards arising from the substance or mixture

Battery may vent when subjected to excessive heat-exposing, fire or over voltage condition. Risk of explosion by fire is anticipated if batteries are disposed of in fire. Firefighting water runoff and dilution water may be toxic and corrosive and may cause adverse environmental impacts.

The interaction of water or water vapour with electrolyte may result in the generation of hydrogen and hydrogen fluoride (HF) gas.

Contact with battery electrolyte may be irritating to the skin, eyes and mucous membranes. Fire will produce irritating, corrosive and/or toxic gases. Fumes may cause dizziness or suffocation.

Lithium-ion batteries contain flammable liquid electrolyte that may vent, ignite and produce sparks when subjected to high temperatures, when damaged or abused.

Burning cells may ignite other cells or objects within close proximity.

5.3 Advice for firefighters

Large lithium-ion battery fires should only be extinguished by properly equipped fire fighters with training specific to lithium ion battery fires.

Wear NIOSH/MSHA/EN469-approved self-contained breathing apparatus (SCBA) and protective clothing when fighting chemical fires.

SECTION 6: Accidental release measures

The material contained within the batteries is only released if the battery is mechanically, thermally, or electrically abused and the enclosure is ruptured.

6.1 Personal precautions, protective equipment and emergency procedures

Evacuate personnel to safe areas
Ensure adequate ventilation, especially in confined areas
Remove all sources of ignition
Avoid contact with skin, eyes and inhalation of vapours
User personal protection recommended in Section 8.3

6.2 Environmental precautions

Prevent further leakage or spillage if safe to do so
Do not allow electrolyte to flow into any sewer, on the ground or into any body of water

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6.3 Methods and material for containment and cleaning up

Add neutralizer/absorbent, e.g. sand or vermiculite, to spill area. Sweep or shovel spilled material and absorbent and place in approved container. Dispose of any non-recyclable materials in accordance with local, state, provincial or federal regulations.

6.4 Reference to other sections

See Section 7 for more information
See Section 8 for more information
See Section 13 for more information

SECTION 7: Handling and storage

7.1 Precautions for safe handling

Do not open, disassemble, crush, puncture, or burn product. If battery case is broken, avoid contact with internal components. Do not handle near heat, sparks, or open flames.
Remove metallic accessories, rings and other jewelry when handling live batteries.
Protect containers from physical damage to avoid leaks and spills.
Place cardboard between layers of stacked batteries to avoid damage and short circuits,
Do not allow conductive material to touch the battery terminals. A dangerous short-circuit may occur and cause battery failure and fire.

7.2 Conditions for safe storage, including any incompatibilities

Insulate positive and negative terminals to avoid short circuit. Avoid mechanical or electrical abuse.
Store product in in cool, dry and ventilated area, which is subjected to little temperature changes. Storage at high temperatures, or exposure to direct sunlight for long periods, should be avoided. The recommended storage temperature is -20°C–45°C, not to exceed 60°C. Elevated temperatures can result in shortened battery life.
Keep out of reach of children.
Store in accordance with local regulations.

7.3 Specific end use(s)

Apart from the uses mentioned in SECTION 1.2 no other specific uses are stipulated.

SECTION 8: Exposure controls / personal protection

8.1 Control parameters

Occupational exposure limits

Exposures to hazardous substances are not expected when product is used for its intended purpose.
See Section 8.2 for ingredients with limit values that require monitoring at the workplace if a battery case has been compromised or damaged.

Biological limit values

Exposures to hazardous substances are not expected when product is used for its intended purpose.

Exposure limits at intended use

Exposures to hazardous substances are not expected when product is used for its intended purpose.

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Derived No Effect Level (DNEL) / Predicted No Effect Concentration (PNEC) values
Not applicable.

Risk management measures according to used control banding approach
Not applicable.

8.2 Ingredients with limit values

Chemical Name / Region	Graphite (CAS #: 7782-42-5)	Copper (CAS #: 7440-50-8)	Aluminium (CAS #: 7429-90-5)	Lithium, Hexa-fluorphosphate ($LiPF_6$) (CAS #: 21324-40-3)
Australia	3 mg/m3	1 mg/m3 0.2 mg/m3	10 mg/m3 5mg/m3	2.5 mg/m3
Austria	STEL: 10 mg/m3 TWA: 5 mg/m3	STEL: 4mg/m3 STEL: 0.4 mg/m3 TWA: 1 mg/m3 TWA: 0.1 mg/m3	STEL 20 mg/m3 TWA: 10 mg/m3	---
Belgium	---	---	---	---
Denmark	TWA: 2.5 mg/m3	TWA: 1.0 mg/m3 TWA: 0.1 mg/m3	TWA: 5 mg/m3 TWA: 2 mg/m3	TWA: 2.5 mg/m3
European Union	---	---	---	---
France	---	TWA: 0.2 mg/m3 TWA: 1 mg/m3 STEL: 2 mg/m3	TWA: 10 mg/m3 TWA: 5 mg/m3	---
Finland	---	TWA: 1 mg/m3 TWA: 0.1 mg/m3	TWA: 1.5 mg/m3	---
Germany	---	TWA: 0.01 mg/m3 Ceiling/peak: 0.02 mg/m3 Ceiling/peak: 0.2 mg/m3	TWA: 4 mg/m3 TWA: 1.5 mg/m3	TWA: 1 mg/m3 Skin
Italy	---	---	---	---
Latvia	---	TWA: 0.5 mg/m3 STEL: 1 mg/m3	TWA: 2 mg/m3	---
Netherlands	---	TWA: 0.1 mg/m3	---	---
Norway	---	TWA: 0.1 mg/m3 TWA: 1 mg/m3 STEL: 0.1 mg/m3 STEL: 1 mg/m3	TWA: 5 mg/m3 STEL: 5 mg/m3	---
Poland	---	---	TWA: 2.5 mg/m3 TWA: 1.2 mg/m3	---
Portugal	---	---	TWA: 10 mg/m3 TWA: 5 mg/m3	---
Spain	---	---	TWA: 10 mg/m3 TWA: 5 mg/m3	---
Switzerland	---	---	TWA: 3 mg/m3	---
United Kingdom	---	---	STEL: 30 mg/m3 STEL: 12 mg/m3 TWA: 10 mg/m3 TWA: 4 mg/m3	---
Other:				
ACGIH TLV	TWA: 2.0 mg/m3 Respirable fraction all forms except graphite fibers	TWA: 0.2 mg/m3 fume TWA: 1 mg/m3 Cu dust and mist	TWA: 1mg/m3 respirable fraction	TWA: 2.5 mg/m3 F

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Chemical Name / Region	Graphite (CAS #: 7782-42-5)	Copper (CAS #: 7440-50-8)	Aluminium (CAS #: 7429-90-5)	Lithium, Hexa-fluorphosphate ($LiPF_6$) (CAS #: 21324-40-3)
OSHA PEL	---	---	TWA: 15 mg/m3 total dust TWA: 5 mg/m3 respirable fraction (vacated) TWA: 15 mg/m3 total dust (vacated) TWA: 5 mg/m3 respirable fraction (vacated) TWA: 5 mg/m3 Al	---
NIOSH IDLH	---	IDLH: 100 mg/m3 dust, fume and mist IDLH: 100 mg/m3 Cu dust and mist TWA: 1 mg/m3 dust and mist TWA: 0.1 mg/m3 fume TWA: 1 mg/m3 Cu dust and mist	TWA: 10 mg/m3 total dust TWA: 5 mg/m3 respirable dust TWA: 5 mg/m3 Al	---

8.3 Exposure controls

Appropriate engineering controls

Not necessary under normal conditions. Broken or leaking batteries should be handled in accordance with good industrial hygiene and safety practices. Wash hands before work breaks and at the end of workday. Do not eat, drink or smoke while handling leaking batteries.

Personal protective equipment

Eye/face protection: Not necessary under conditions of normal use. In case of battery rupture or leakage, wear safety goggles or side shields when handling.

Skin protection: Not necessary under conditions of normal use. In case of battery rupture or leakage, wear rubber apron and nitrile, neoprene, or natural rubber gloves when handling an open or leaking battery. Inspect gloves prior to use. Change disposable gloves within 30 minutes of obvious contamination by electrolyte. Remove dirty gloves by appropriate technique. Do not touch outer surface of glove.

Respiratory protection: Not necessary under conditions of normal use. In case of battery venting or rupture, inside an enclosed space, use NIOSH approved or equivalent self-contained breathing apparatus.

8.4 Environmental exposure controls

Comply with the handling and storage guidelines in Section 7. Do not allow any spilled electrolyte from damaged product in any sewer, on the ground, or into any body of water.

SECTION 9: Physical and Chemical Properties

9.1 Information on the basic physical and chemical properties

Appearance — Solid. Battery system, battery module, or cell.

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Color	Grey
Odor	Odourless
Odor threshold	Not applicable
pH	Not applicable
Melting point / freezing point	Not applicable
Initial boiling point / boiling range	Not applicable
Flash point	Not applicable
Evaporation rate	Not applicable
Flammability	Not applicable
Flammability limit in air	Not applicable
Vapor pressure	Not applicable
Vapor density	Not applicable
Density	Not applicable
Specific gravity	Not available
Solubility in water	Insoluble
Partition coefficient: n-octanol/water	Not applicable
Auto-ignition temperature	Not applicable
Decomposition temperature	Not applicable
Viscosity	Not applicable
Explosive properties	Not applicable
Oxidizing properties	Not applicable

9.2 Other information

Electrical specifications

Product Model	**Nominal Voltage** (V)	**Electric Capacity** (Ah)	**Electric Energy** (Wh)	**Marketing Name**
12-48-6650	51.2	130	6656	12-48-6650
42-48-6650	51.2	130	6656	42-48-6650
14-24-2800	25.6	110	2816	14-24-2800
44-24-2800	25.6	110	2816	44-24-2800
15-24-1000	25.6	40	1024	15-24-1000
12-36-6700	38.4	175	6720	12-36-6700
15-36-1000	38.4	25	960	15-36-1000
IFR32650	3.2	5	16	n/a
900-0066	51.2	30	1536	46-48-1540
900-0065	25.6	60	1536	46-24-1540
900-0054	51.2	30	1536	DLP-GC2-48V
900-0053	38.4	30	1152	DLP-GC2-36V
900-0052	25.6	60	1536	DLP-GC2-24V
900-0051	12.8	120	1536	DLP-GC2-12V
900-0050	25.6	100	2560	DLB-GC12-24V
900-0049	12.8	200	2560	DLB-GC12-12V
900-0048	38.4	30	1152	DLB-G24-36V
900-0047	25.6	45	1152	DLB-G24-24V
900-0046	12.8	100	1280	DLB-G24-12V
900-0044	12.8	228	2918	14-12-3000

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900-0043	25.6	114	2918	14-24-3000
900-0042	38.4	76	2918	14-36-3000
900-0041	51.2	57	2918	14-48-3000 / 44-48-3000
590-0080	51.2	57	2918	n/a
590-0086	38.4	76	2918	n/a
590-0090	25.6	114	2918	n/a
590-0097	12.8	228	2918	n/a
IFR26650P	3.2	3.8	12	n/a

SECTION 10:Stability and reactivity

10.1 Reactivity

Stable under recommended storage and handling conditions (see Section 7, Handling and storage)

10.2 Chemical stability

Stable under recommended storage conditions.

10.3 Possibility of hazardous reactions

A shorted lithium battery can cause thermal and chemical burns upon contact with the skin.

If a battery is severely heated by a surrounding fire, acrid or harmful fumes may be emitted.

If leaked, do not allow contact with strong oxidizers, mineral acids, strong alkalis, halogenated hydrocarbons.

10.4 Conditions to avoid

Avoid mechanical or electrical abuse, including: external short circuit of battery, deformation by crush, direct sunlight, high humidity, temperatures exceeding 60°C, puncture, sources of ignition, or installation with incorrect polarity.

10.5 Incompatible materials

Strong bases, combustible organic materials, reducing agents, strong oxidizers, and sea water or other electrically conductive liquids.

10.6 Hazardous decomposition products

A compromised battery may emit irritating or toxic fumes and gases, including metallic oxide, hydrogen fluoride, carbon monoxide, and carbon monoxide.

SECTION 11:Toxicological information

11.1 Information on toxicological effects

Acute Toxicity

Chemical Name	Oral LD50	Dermal LD50	Inhalation LC50
Copper (CAS #: 7440-50-8)	> 2500 mg/kg bw (rat)	> 2000 mg/kg bw (rat)	= 1.03 mg/L/4 h (rat)
Aluminium (CAS #: 7429-90-5)	> 15900 mg/kg bw(rat)	---	> 0.888 mg/L/4 h (rat)
Ferrum (CAS # 7439-89-6)	> 7500 mg/kg bw (rat)	---	---

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Skin corrosion/irritation	Non-irritating to the skin under normal conditions
Serious eye damage/irritation	No eye irritation under normal conditions
Respiratory or skin sensitization	No information available.
Germ cell mutagenicity	No information available.
Carcinogenicity	Risk of exposure occurs only if the battery enclosure is compromised.
Reproductive toxicity	Risk of exposure occurs only if the battery enclosure is compromised.
STOT-single exposure	No information available.
STOT-repeated exposure	No information available.
Aspiration hazard	No information available.

SECTION 12:Ecological information

When properly used or disposed, the batteries do not present environmental hazard.

12.1 Toxicity

Chemical Name	Algae/aquatic plants EC50	Fish LC50	Crustacea EC50
Copper (CAS #: 7440-50-8)	0.031 – 0.054 mg/L/96h Pseudokirchnerilla subcapitata static 0.0426 – 0.0535 mg/L/72h Pseudokirchneriella subcapitata static	1.25: 96h Lepomis macrochirus mg/L LC50 static 0.3: 96h Cyprinus carpio mg/L LC50 semi-static 0.8: 96h Cyprinus carpio mg/L LG50 Static 0.112: 96 h Poecilia reticulate mg/L LC50 Flow-through 0.0068 – 0.0156: 96 h Pimephales promelas mg/L LC50 0.3: 96h Pimephales promelas mg/L LC50 static 0.2: 96h Pimephales promelas mg/L LC50 flow-through 0.052: 96h Orcorhynchus mykiss mg/L LC50 flow-through	---
Aluminium (CAS #: 7429-90-5)	---	> 50 mg/L/96h	---

12.2 Persistence and degradability

Not readily biodegradable.

12.3 Bioaccumulative potential

No information available.

12.4 Mobility in soil

No information available.

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12.5 Results of PBT and vPvB assessment

Not applicable.

12.6 Other adverse effects

Batteries and cells released in the environment will slowly degrade and may release toxic or harmful substances. Batteries should be disposed or recycled according to local regulations.

SECTION 13:Disposal considerations

13.1 Waste treatment methods

Recycling is encouraged. Do not throw out a used battery or cell in the landfill. Electrolyte should not be dumped into any sewers, on the ground, or into any body of water. Recycle through a qualified recycling company.

Canada	Dispose of in accordance with local, state and federal laws and regulations.
Europe	Dispose of in accordance with relevant EC Directives and national, regional, and local environmental control regulations. For disposal within the EC, the appropriate code according to the European List of Wastes (LoW) should be used.
USA	Dispose of in accordance with local, state and federal laws and regulations.

Following local, State/Provincial, and Federal/National regulations applicable to end-of-life characteristics is the responsibility of the end user. Store material for disposal as indicated in Section 7.

SECTION 14:Transport information

All Discover AES battery models (and their internal cells) have independently passed testing required by Section 38.3 of the UN Manual of Tests and Criteria.

14.1 UN number

Air transport (ICAO/IATA)	UN3480 (only for 15-24-1000, 15-36-1000, IFR32650, IFR26650P, 900-0046, 900-0047, 900-0048, 900-0049, 900-0050, 900-0051, 900-0052, 900-0053, 900-0054, 900-0065, 900-0066)
Sea transport (IMDG)	UN3480
Inland waterway transport (ADN)	UN3480
Land transport (ADR/RID)	UN3480

14.2 Proper shipping name

Air transport (ICAO/IATA)	Lithium Ion Batteries (only for 15-24-1000, 15-36-1000, IFR32650, IFR26650P, 900-0046, 900-0047, 900-0048, 900-0049, 900-0050, 900-0051, 900-0052, 900-0053, 900-0054, 900-0065, 900-0066)
Sea transport (IMDG)	Lithium Ion Batteries
Inland waterway transport (ADN)	Lithium Ion Batteries
Land transport (ADR/RID)	Lithium Ion Batteries

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14.3 Hazard Class

Air transport (ICAO/IATA)	9 (only for 15-24-1000, 15-36-1000, IFR32650, IFR26650P, 900-0046, 900-0047, 900-0048, 900-0049, 900-0050, 900-0051, 900-0052, 900-0053, 900-0054, 900-0065, 900-0066)
Sea transport (IMDG)	9
Inland waterway transport (ADN)	9
Land transport (ADR/RID)	9

14.4 Packing Group

Air transport (ICAO/IATA)	II (only for 15-24-1000, 15-36-1000, IFR32650, IFR26650P, 900-0046, 900-0047, 900-0048, 900-0049, 900-0050, 900-0051, 900-0052, 900-0053, 900-0054, 900-0065, 900-0066)
Sea transport (IMDG)	II
Inland waterway transport (ADN)	II
Land transport (ADR/RID)	II

14.5 Environmental Hazards

Dangerous goods

14.6 Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code

Worldwide air transportation:	The goods are packaged according to Section 1A of PACKING INSTRUCTION 965 of the 2016 IATA Dangerous Goods. Lithium-ion batteries may be air transported on CARGO AIRCRAFT ONLY and are forbidden in passenger aircraft.
Worldwide sea transportation:	The goods are packaged according to the special provision 188 of IMDG. IMO-IMDG Code [P903]

14.7 Labeling

Use Class 9 Miscellaneous Dangerous Goods and UN Identification labels for transportation of lithium-ion batteries which are assigned Class 9. Refer to relevant transportation documents. Lithium and lithium-ion cells and batteries are regulated in the USA in accordance with Part 49 Regulations of the Code of Federal Regulations, (49 CFR Sections 105-180) of the U.S. Hazardous Materials Regulations.

Lithium-ion batteries, under UN3480, PI 965, Section 1A, must be declared as CARGO AIRCRAFT ONLY (CAO) if shipped by air.

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SECTION 15:Regulatory information

15.1 Safety, health, and environmental regulations/legislation specific for the substance or mixture

Canada

This is not a controlled product under WHMIS. This product meets the definition of a “manufactured article” and is not subject to the regulations of the Hazardous Products Act.

All ingredients in the product are listed, as required, on the DSL/NDSL.

This product does not contain any NPRI Substances.

Europe

Under normal use, this product is not classified as hazardous according to:
Regulation (EC) No 1272/2008
Directive 67/548/EEC
Directive 1999/45/EC

Risk phrases	None
Safety phrases	S2: Keep out of the reach of children.

USA

This product is an article pursuant to 29 CFR 1910.1200 and, as such, is not subject to the OSHA hazard communication standard requirement.

TSCA Status	All ingredients in the product are listed on the TSCA inventory.
SARA Title III	
Sec. 302/304	None
Sec. 311/312	None
Sec. 313	None
CERCLA RQ	None
California Prop 65	This product does not contain chemicals know to the State of California to cause cancer or reproductive toxicity.

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SECTION 16:Other information

This material Safety Data Sheet (SDS) complies with the requirements of Regulation (EC) No. 1907/2006.

16.1 Revision summary

August 26, 2016	New document
November 1, 2016	Updated 24-hour emergency contact number
November 10, 2017	Added new models 15-36-1000, 12-36-6700; updated Discover logo
January 23, 2019	Updated Packing Group, Labelling
December 19, 2019	Added new models 14-3k series batteries and 26650 cell
July 28, 2020	Clarification of Product Names and Models.
December 15, 2021	Added new models (900-0046, 900-0047, 900-0048, 900-0049, 900-0050, 900-0051, 900-0052, 900-0053, 900-0054, 900-0065, 900-0066); Updated Sections 9.2 and 14 to reflect the additions of these models.

16.2 Terms & Definitions

Key or legend to abbreviations and acronyms used in the SDS:

AICS	Australian Inventory of Chemical Substances
Ceiling	Maximum limit value
DSL/NDSL	Canadian Domestic Substances List / Non-Domestic Substances List
ENCS	Japan Existing and New Chemical Substances
EINECS/ELINCS	European Inventory of Existing Chemical Substances / European List of Notified
IATA	International Air Transport Association
IECSC	China Inventory of Existing Chemical Substances
IMDG	International Maritime Dangerous Goods
KECL	Korean Existing and Evaluated Chemical Substances
NPRI	National Pollutant Release Inventory
STEL	Short Term Exposure Limit
TSCA	United States Toxic Substances Control Act Section 8(b) Inventory
STOT RE	Specific Target Organ Toxicity – repeated exposure
TWA	Time Weighted Average
WHMIS	Workplace Hazardous Materials Information System

Full text of H-Statements referred to under Section 3

H228	Flammable solid
H261	Contact with water releases flammable gases
H301	Toxic if swallowed
H314	Causes severe skin burns and eye damage
H317	May cause an allergic reaction
H351	Suspected of causing cancer
H372	Causes damage to organs through prolonged or repeated exposure if inhaled
H412	Harmful to aquatic life with long lasting effects

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16.3 Manufacturer disclaimer

THE INFORMATION ABOVE IS BELIEVED TO BE ACCURATE AND REPRESENTS THE BEST INFORMATION CURRENTLY AVAILABLE TO US. HOWEVER, DISCOVER ENERGY BATTERY MAKES NO WARRANTY OF MERCHANTABILITY OR ANY OTHER WARRANTY, EXPRESSED OR IMPLIED, WITH RESPECT TO SUCH INFORMATION, AND WE ASSUME NO LIABILITY RESULTING FROM ITS USE. USERS SHOULD MAKE THEIR OWN INVESTIGATIONS TO DETERMINE THE SUITABILITY OF THE INFORMATION FOR THEIR PARTICULAR PURPOSES. ALTHOUGH REASONABLE PRECAUTIONS HAVE BEEN TAKEN IN THE PREPARATION OF THE DATA CONTAINED HEREIN, IT IS OFFERED SOLELY FOR YOUR INFORMATION, CONSIDERATION AND INVESTIGATION. THIS SAFETY DATA SHEET PROVIDES GUIDELINES FOR THE SAFE HANDLING AND USE OF THIS PRODUCT; IT DOES NOT AND CANNOT ADVISE ON ALL POSSIBLE SITUATIONS, THEREFORE, YOUR SPECIFIC USE OF THIS PRODUCT SHOULD BE EVALUATED TO DETERMINE IF ADDITIONAL PRECAUTIONS ARE REQUIRED.

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SAFETY DATA SHEET

1. Identification

Product identifier **HyVolt III**

Other means of identification None.

Recommended use Transformer Oil

Recommended restrictions None known.

Manufacturer/Importer/Supplier/Distributor information

Company: Ergon, Inc.

Address: P.O. Box 1639
Jackson, MS 39215

E-mail: sds@ergon.com

Emergency Contacts

Customer Service: 1-800-222-7122

Chemtrec: 1-800-424-9300 After Business Hours (North America Only)
1-703-527-3887 After Business Hours (International)

2. Hazard(s) identification

Physical hazards Not classified.

Health hazards Aspiration hazard Category 1

Environmental hazards Not classified.

OSHA defined hazards Not classified.

Label elements

Signal word Danger

Hazard statement May be fatal if swallowed and enters airways.

Precautionary statement

Prevention Do not breathe gas/mist/vapors/spray.

Response IF SWALLOWED: Immediately call a POISON CENTER/doctor. Do NOT induce vomiting.

Storage Store locked up.

Disposal Dispose of contents/container in accordance with local/regional/national/international regulations.

Hazard(s) not otherwise classified (HNOC) None known.

Supplemental information None.

3. Composition/information on ingredients

Mixtures

Chemical name	Common name and synonyms	CAS number	%
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC		64742-53-6	30 - 99.6
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT		64742-47-8	0 - 55
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT PARAFFINIC		64742-55-8	0 - 50
LUBRICATING OILS (PETROLEUM), C20-50, HYDROTREATED NEUTRAL OIL-BASED		72623-87-1	0 - 20

Chemical name	Common name and synonyms	CAS number	%
2,6-DI-TERT-BUTYL-P-CRESOL		128-37-0	< 0.4
Other components below reportable levels			15.37

4. First-aid measures

Inhalation Move to fresh air. Oxygen or artificial respiration if needed. Do not use mouth-to-mouth method if victim inhaled the substance. Call a physician or poison control center immediately.

Skin contact Wash contact areas with soap and water. Remove contaminated clothing. Launder contaminated clothing before reuse. Get medical attention if irritation develops and persists.

Eye contact Immediately flush eyes with plenty of water for at least 15 minutes. Remove contact lenses, if present and easy to do. Continue rinsing. Get medical attention if irritation develops and persists.

Ingestion Rinse mouth thoroughly. Do NOT induce vomiting. If vomiting occurs, keep head low so that stomach content doesn't get into the lungs. Never give liquid to an unconscious person. Call a poison control center immediately.

Most important symptoms/effects, acute and delayed Aspiration may cause pulmonary edema and pneumonitis. Headache. Dizziness. Nausea, vomiting. Diarrhea. Defatting of the skin. Droplets of the product aspirated into the lungs through ingestion or vomiting may cause a serious chemical pneumonia.

Indication of immediate medical attention and special treatment needed Provide general supportive measures and treat symptomatically. Keep victim under observation. Symptoms may be delayed.

General information Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves. Keep victim under observation. Contact physician if discomfort continues.

5. Fire-fighting measures

Suitable extinguishing media Halon. Dry chemicals. Foam. Carbon dioxide (CO2). Water spray or fog. Do not use water jet as an extinguisher, as this will spread the fire.

Unsuitable extinguishing media Do not use water jet as an extinguisher, as this will spread the fire.

Specific hazards arising from the chemical No unusual fire or explosion hazards noted.

Special protective equipment and precautions for firefighters Wear full protective clothing, including helmet, self-contained positive pressure or pressure demand breathing apparatus, protective clothing and face mask.

Fire fighting equipment/instructions Firefighters must use standard protective equipment including flame retardant coat, helmet with face shield, gloves, rubber boots, and in enclosed spaces, SCBA. Cool containers exposed to heat with water spray and remove container, if no risk is involved. Cool containers exposed to flames with water until well after the fire is out.

Specific methods Use standard firefighting procedures and consider the hazards of other involved materials.

General fire hazards No unusual fire or explosion hazards noted.

6. Accidental release measures

Personal precautions, protective equipment and emergency procedures Keep unnecessary personnel away. Keep people away from and upwind of spill/leak. Wear appropriate protective equipment and clothing during clean-up. Do not touch damaged containers or spilled material unless wearing appropriate protective clothing. Ensure adequate ventilation. Local authorities should be advised if significant spillages cannot be contained. For personal protection, see section 8 of the SDS.

Methods and materials for containment and cleaning up ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area). Absorb in vermiculite, dry sand or earth or absorbent material then place into containers. The product is immiscible with water and will spread on the water surface.

Large Spills: Stop the flow of material, if this is without risk. Dike the spilled material, where this is possible. Cover with plastic sheet to prevent spreading. Absorb in vermiculite, dry sand or earth and place into containers. Following product recovery, flush area with water.

Small Spills: Wipe up with absorbent material (e.g. cloth, fleece). Clean surface thoroughly to remove residual contamination.

Never return spills to original containers for re-use. For waste disposal, see section 13 of the SDS.

Environmental precautions Prevent further leakage or spillage if safe to do so. Avoid discharge into drains, water courses or onto the ground. Prevent entry into waterways, sewer, basements or confined areas. Avoid release to the environment. Contact local authorities in case of spillage to drain/aquatic environment.

7. Handling and storage

Precautions for safe handling

DO NOT handle, store or open near an open flame, sources of heat or sources of ignition. Protect material from direct sunlight. Wash hands after handling and before eating. Do not breathe dust/fume/gas/mist/vapors/spray. Do not get this material in contact with eyes. Do not get this material on clothing. Avoid contact with skin. Avoid prolonged exposure. Use only in well-ventilated areas. Wear appropriate personal protective equipment. Observe good industrial hygiene practices. Shower after work. Remove and wash contaminated clothing promptly.

Conditions for safe storage, including any incompatibilities

Store locked up. Keep away from heat and sources of ignition. Store in tightly closed container. Store in a well-ventilated place. Store away from incompatible materials (see Section 10 of the SDS).

8. Exposure controls/personal protection

Occupational exposure limits

The following constituents are the only constituents of the product which have a PEL, TLV or other recommended exposure limit. At this time, the other constituents have no known exposure limits.

US. OSHA Table Z-1 Permissible Exposure Limits (PEL) for Air Contaminants (29 CFR 1910.1000)

Components	Type	Value	Form
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC (CAS 64742-53-6)	PEL	5 mg/m3	Mist.
		2000 mg/m3	
		500 ppm	

US. ACGIH Threshold Limit Values (TLV)

Components	Type	Value	Form
2,6-DI-TERT-BUTYL-P-CRESOL (CAS 128-37-0)	TWA	2 mg/m3	Inhalable fraction and vapor.
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC (CAS 64742-53-6)	TWA	5 mg/m3	Inhalable fraction.
LUBRICATING OILS (PETROLEUM), C20-50, HYDROTREATED NEUTRAL OIL-BASED (CAS 72623-87-1)	TWA	5 mg/m3	Inhalable fraction.

NIOSH. Immediately Dangerous to Life or Health (IDLH) Values, as amended

Components	Type	Value
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC (CAS 64742-53-6)	IDLH	2500 mg/m3

US. NIOSH: Pocket Guide to Chemical Hazards Recommended Exposure Limits (REL)

Material	Type	Value	Form
HyVolt III	STEL	10 mg/m3	Mist.
	TWA	5 mg/m3	Mist.

Components	Type	Value	Form
2,6-DI-TERT-BUTYL-P-CRESOL (CAS 128-37-0)	TWA	10 mg/m3	
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT (CAS 64742-47-8)	TWA	100 mg/m3	

US. NIOSH: Pocket Guide to Chemical Hazards Recommended Exposure Limits (REL)

Components	Type	Value	Form
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC (CAS 64742-53-6)	Ceiling	1800 mg/m3	
	STEL	10 mg/m3	Mist.

Biological limit values No biological exposure limits noted for the ingredient(s).

Appropriate engineering controls Provide adequate ventilation, including appropriate local extraction, to ensure that the defined occupational exposure limit is not exceeded.

Individual protection measures, such as personal protective equipment

Eye/face protection Wear safety glasses with side shields (or goggles).

Skin protection

Hand protection Chemical resistant gloves are recommended. If contact with forearms is likely wear gauntlet style gloves.

Other Chemical/oil resistant clothing is recommended. Launder contaminated clothing before reuse.

Respiratory protection In case of insufficient ventilation, wear suitable respiratory equipment.

Thermal hazards Wear appropriate thermal protective clothing, when necessary.

General hygiene considerations Always observe good personal hygiene measures, such as washing after handling the material and before eating, drinking, and/or smoking. Routinely wash work clothing and protective equipment to remove contaminants.

9. Physical and chemical properties

Appearance Clear & bright

Physical state Liquid.

Form Liquid.

Color L0.5

Odor Mild Petroleum Odor

Odor threshold Not available.

pH Not determined.

Melting point/freezing point -81.4 °F (-63 °C) ASTM D5950/ISO 3016

Initial boiling point and boiling range 548.6 °F (287 °C) ASTM D2887/ ISO 3294

Flash point 312.8 °F (156.0 °C)

Evaporation rate Not available.

Flammability (solid, gas) Will burn if involved in a fire.

Upper/lower flammability or explosive limits

Explosive limit - lower (%) Not available.

Explosive limit - upper (%) Not available.

Vapor pressure Not determined.

Vapor density Not determined.

Relative density 0.88 (68 °F (20 °C) ASTM D4052/ ISO 12185)

Solubility(ies)

Solubility (water) Insoluble

Partition coefficient (n-octanol/water) Not established.
Not applicable.

Auto-ignition temperature ≥599 °F (≥315 °C) ASTM E659

Decomposition temperature Not determined.

Viscosity Not available.

Other information

Explosive properties Not explosive.

Kinematic viscosity	9.4 mm²/s ISO 3104 (104 °F (40 °C))
Oxidizing properties	Not oxidizing.

10. Stability and reactivity

Reactivity	The product is stable and non-reactive under normal conditions of use, storage and transport.
Chemical stability	Stable.
Possibility of hazardous reactions	Hazardous polymerization does not occur.
Conditions to avoid	Heat, flames and sparks. Avoid temperatures exceeding the flash point. Contact with incompatible materials.
Incompatible materials	Strong oxidizing agents. Strong oxidizing agents.
Hazardous decomposition products	Upon decomposition, this product emits carbon monoxide, carbon dioxide and/or low molecular weight hydrocarbons.

11. Toxicological information

Information on likely routes of exposure

Inhalation	May be fatal if swallowed and enters airways.
Skin contact	Frequent or prolonged contact may defat and dry the skin, leading to discomfort and dermatitis.
Eye contact	Direct contact with eyes may cause temporary irritation.
Ingestion	May cause gastrointestinal discomfort if swallowed. Do not induce vomiting. Vomiting may increase risk of product aspiration.
Symptoms related to the physical, chemical and toxicological characteristics	Aspiration may cause pulmonary edema and pneumonitis. Headache. Dizziness. Nausea, vomiting. Diarrhea. Coughing. Discomfort in the chest. Shortness of breath. Defatting of the skin.

Information on toxicological effects

Acute toxicity

Components	Species	Test Results
2,6-DI-TERT-BUTYL-P-CRESOL (CAS 128-37-0)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
	Rat	> 2000 mg/kg
Oral		
LD50	Rat	> 6000 mg/kg
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT (CAS 64742-47-8)		
Acute		
Dermal		
LD50	Rat	> 2000 mg/kg
Inhalation		
LC50	Rat	> 5200 mg/m3, 4 Hours
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT PARAFFINIC (CAS 64742-55-8)		
Acute		
Dermal		
LD50	Rat	> 2000 mg/kg
Oral		
LD50	Rat	> 5000 mg/kg
LUBRICATING OILS (PETROLEUM), C20-50, HYDROTREATED NEUTRAL OIL-BASED (CAS 72623-87-1)		
Acute		
Dermal		
LD50	Rabbit	> 2000 mg/kg
Oral		
LD50	Rat	> 5000 mg/kg

Skin corrosion/irritation Prolonged skin contact may cause temporary irritation.

Serious eye damage/eye irritation Prolonged exposure may cause irritation to eyes.

Respiratory or skin sensitization

Respiratory sensitization Not a respiratory sensitizer.

Skin sensitization Not classified. May cause defatting of the skin, but is neither an irritant nor a sensitizer.

Germ cell mutagenicity No data available to indicate product or any components present at greater than 0.1% are mutagenic or genotoxic.

Carcinogenicity This product is not considered to be a carcinogen by IARC, ACGIH, NTP, or OSHA. Meets EU requirement of less than 3% (w/w) DMSO extract for total polycyclic aromatic compound (PAC) using IP 346.

IARC Monographs. Overall Evaluation of Carcinogenicity

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT NAPHTHENIC (CAS 64742-53-6)	3 Not classifiable as to carcinogenicity to humans.
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT PARAFFINIC (CAS 64742-55-8)	3 Not classifiable as to carcinogenicity to humans.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

US. National Toxicology Program (NTP) Report on Carcinogens

Not listed.

Reproductive toxicity This product is not expected to cause reproductive or developmental effects.

Specific target organ toxicity - single exposure Not classified.

Specific target organ toxicity - repeated exposure Not classified.

Aspiration hazard May be fatal if swallowed and enters airways.

Chronic effects Prolonged inhalation may be harmful. Prolonged exposure may cause chronic effects.

Further information Risk of chemical pneumonia after aspiration.

12. Ecological information

Ecotoxicity Harmful to aquatic life with long lasting effects.

Product		**Species**	**Test Results**
HyVolt III			
Aquatic			
Crustacea	EC50	Daphnia	24.3982 mg/l, 48 hours estimated
Fish	LC50	Fish	58.5556 mg/l, 96 hours estimated
Acute			
Crustacea	EC50	Daphnia	16.8277 mg/l, 48 hours estimated
Fish	LC50	Fish	13.0178 mg/l, 4 days estimated
Components		**Species**	**Test Results**
2,6-DI-TERT-BUTYL-P-CRESOL (CAS 128-37-0)			
Aquatic			
Acute			
Algae	EC10	Freshwater algae	0.24 mg/l, 72 hours
Crustacea	EC50	Daphnia magna	0.48 mg/l, 48 hours
Fish	LC50	Fish	0.199 mg/l, 96 hours
Chronic			
Crustacea	NOEC	Daphnia magna	0.069 mg/l, 21 days
Fish	NOEC	Fish	0.053 mg/l, 30 days
DISTILLATES (PETROLEUM), HYDROTREATED LIGHT (CAS 64742-47-8)			
Aquatic			
Acute			
Fish	LC50	Bluegill (Lepomis macrochirus)	2.2 mg/l, 4 days

Not available. * Estimates for product may be based on additional component data not shown.

Persistence and degradability Expected to be inherently biodegradable.

Bioaccumulative potential Bioaccumulation is unlikely to be significant because of the low water solubility of this product.

Partition coefficient n-octanol / water (log Kow)

2,6-DI-TERT-BUTYL-P-CRESOL	5.1

Mobility in soil Expected to be slightly to moderately mobile in soil.

Other adverse effects Oil spills are generally hazardous to the environment. The product contains volatile organic compounds which have a photochemical ozone creation potential.

13. Disposal considerations

Disposal instructions Collect and reclaim or dispose in sealed containers at licensed waste disposal site. Dispose of contents/container in accordance with local/regional/national/international regulations. Do not contaminate ponds, waterways or ditches with chemical or used container.

Local disposal regulations Dispose in accordance with all applicable regulations.

Hazardous waste code The waste code should be assigned in discussion between the user, the producer and the waste disposal company.

Waste from residues / unused products Dispose of in accordance with local regulations. Empty containers or liners may retain some product residues. This material and its container must be disposed of in a safe manner (see: Disposal instructions). Avoid discharge into water courses or onto the ground.

Contaminated packaging Empty containers should be taken to an approved waste handling site for recycling or disposal. Since emptied containers may retain product residue, follow label warnings even after container is emptied. Offer rinsed packaging material to local recycling facilities.

14. Transport information

DOT

Not regulated as dangerous goods.

IATA

Not regulated as dangerous goods.

IMDG

Not regulated as dangerous goods.

Transport in bulk according to Annex II of MARPOL 73/78 and the IBC Code This product is a liquid. Therefore, bulk transport is governed by MARPOL 73/78, Annex I.

General information Not regulated as dangerous goods.

15. Regulatory information

US federal regulations All components are on the U.S. EPA TSCA Inventory List.

This product is a "Hazardous Chemical" as defined by the OSHA Hazard Communication Standard, 29 CFR 1910.1200.

CERCLA/SARA Hazardous Substances - Not applicable.

HyVolt oils are certified to be PCB-free. HyVolt oils are processed from naturally occurring raw materials with no additives or recycled oils that might introduce PCB contamination.

Toxic Substances Control Act (TSCA) One or more components of the mixture are not on the TSCA 8(b) inventory or are designated "inactive".

TSCA Section 12(b) Export Notification (40 CFR 707, Subpt. D)

Not regulated.

CERCLA Hazardous Substance List (40 CFR 302.4)

DISTILLATES (PETROLEUM), HYDROTREATED LIGHT (CAS 64742-47-8)	Listed.

SARA 304 Emergency release notification

Not regulated.

OSHA Specifically Regulated Substances (29 CFR 1910.1001-1053)

Not listed.

Superfund Amendments and Reauthorization Act of 1986 (SARA)

SARA 302 Extremely hazardous substance

Not listed.

SARA 311/312 Hazardous chemical Yes

Classified hazard categories Aspiration hazard

SARA 313 (TRI reporting)

Not regulated.

Other federal regulations

Clean Air Act (CAA) Section 112 Hazardous Air Pollutants (HAPs) List

Not regulated.

Clean Air Act (CAA) Section 112(r) Accidental Release Prevention (40 CFR 68.130)

Not regulated.

Safe Drinking Water Act (SDWA) Not regulated.

International Inventories

Country(s) or region	Inventory name	On inventory (yes/no)*
Australia	Australian Inventory of Industrial Chemicals (AICIS)	Yes
Canada	Domestic Substances List (DSL)	Yes
Canada	Non-Domestic Substances List (NDSL)	No
China	Inventory of Existing Chemical Substances in China (IECSC)	Yes
Europe	European Inventory of Existing Commercial Chemical Substances (EINECS)	Yes
Europe	European List of Notified Chemical Substances (ELINCS)	No
Japan	Inventory of Existing and New Chemical Substances (ENCS)	Yes
Korea	Existing Chemicals List (ECL)	Yes
New Zealand	New Zealand Inventory	Yes
Philippines	Philippine Inventory of Chemicals and Chemical Substances (PICCS)	Yes
Taiwan	Taiwan Chemical Substance Inventory (TCSI)	Yes
United States & Puerto Rico	Toxic Substances Control Act (TSCA) Inventory	Yes

*A "Yes" indicates that all components of this product comply with the inventory requirements administered by the governing country(s)
A "No" indicates that one or more components of the product are not listed or exempt from listing on the inventory administered by the governing country(s).

16. Other information, including date of preparation or last revision

Issue date 05-07-2014

Revision date 07-26-2024

Version # 21

Further information CHEMTREC Korea: 003-0813-2549 Local CHEMTREC Numbers:
CHEMTREC Mexico: 1-800-681-9531

NFPA ratings Health: 1
Flammability: 1
Instability: 0

List of abbreviations CEN: European Committee for Standardization (Comité Européen de Normalisation).
TLV: Threshold Limit Value.
TWA: Time Weighted Average.
vPvB: very Persistent, very Bioaccumulative.
PBT: Persistent, bioaccumulative, toxic.
STEL: Short-term Exposure Limit.

References

ACGIH
ACGIH Documentation of the Threshold Limit Values and Biological Exposure Indices
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Korea. Dangerous Substances Threshold Quantity (Presidential Decree of Dangerous Substances Safety Management Act No. 18406, Schedule 1)
Korea. Regulated volatile organic compounds (VOCs) (MOE Notice No. 2001-36, March 8, 2001, as amended)
National Toxicology Program (NTP) Report on Carcinogens
NLM: Hazardous Substances Data Base
US. IARC Monographs on Occupational Exposures to Chemical Agents
Chemical Abstracts Service Registry Handbook
CRC: Handbook of Chemistry and Physics
ILO Safety Cards
International Labour Organization
International Maritime Organization Marine Pollutants List
NFPA Hazardous Chemical Data Sheets
NIOSH Pocket Guide
Registry of Toxic Effects of Chemical Substances (RTECS)
US DOT Hazardous Materials Regulations

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Revision information

This document has undergone significant changes and should be reviewed in its entirety.