



CSI 314 AH CELL

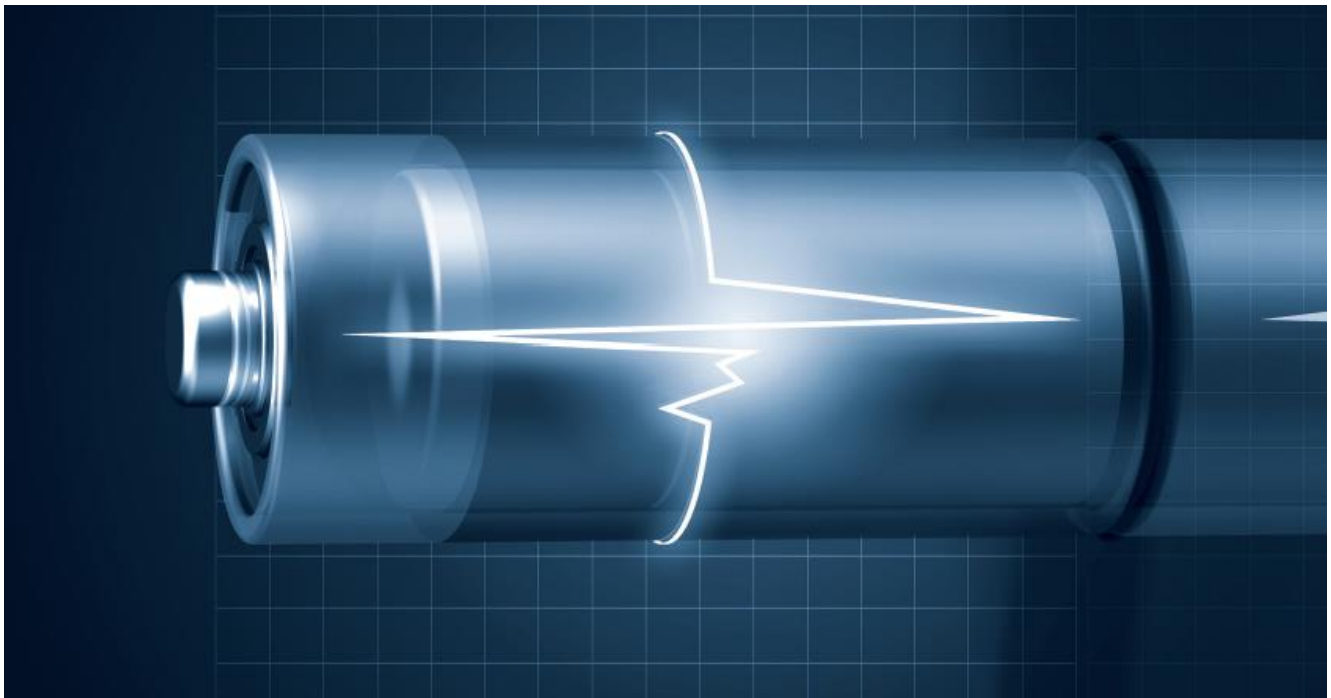
CSI 314 Ah Cell Technology Review

CSI ENERGY STORAGE CO.,LTD

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Customer:	CSI Energy Storage Co.,Ltd	Hotel, No. 1591 Hongqiao Road,
Address:	No.348 Lushan Road, Suzhou City, Jiangsu, China	Changning District, 200030, Shanghai
Contact person:	Mr. Xiaowei Lu	
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Prepared by:

Verified by:

Approved by:

Yifu Wang
Senior Consultant, Energy Storage Service APAC

Majid Rasool
Ridhvik Gopal
Senior Consultant, Energy Storage Technology USA

Yongshan Xiao
Head of Section, Energy Storage APAC

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List of abbreviations

The following table lists some of the abbreviations used in this Report.

Acronym	Abbreviation
AC	Alternating Current
Ah	Ampere-hour
BESS	Battery Energy Storage System
BOL	Beginning of Life
CAPA	Corrective and preventive action
CAR	Corrective action request
CSE	Canadian Solar e-Storage
C-rate	Current Rate
DC	Direct Current
EPC	Engineering, Procurement, and Construction
EOL	End of Life
ESS	Energy Storage System
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronics Engineers
NOC	Network operation center
O&M	Operation & Maintenance
P-rate	Power Rate
PV	Photovoltaic
RoHS	Restriction of Hazardous Substances Directive
SOC	State of Charge
SOH	State of Health
SOP	Standard operating procedure
SSES	System Solutions and Energy Storage
UL	Underwriters Laboratories
UN	United Nations
V	Voltage
Wh	Watt-hour

EXECUTIVE SUMMARY

CSI Energy Storage Co.,Ltd (the “Customer” or “CSI”) has engaged DNV China Company Limited (hereinafter “DNV”) to complete a technical due diligence evaluation of CSI’s 314 Ah battery cell. This evaluation is intended to serve as third-party assessment of the CSI’s battery product. DNV reviewed CSI’s product specification, design for functionality and safety, performance, product warranties, and manufacturing capabilities.

Company Overview

Canadian Solar Inc. (“CSI”) is a vertically integrated solar and energy storage solutions provider. It was founded in 2001, Ontario, Canada. Initially, the company produced portable solar chargers for automobile batteries.

CSI, through its subsidiaries, operates globally as a developer of photovoltaic (PV) and battery energy storage system (“BESS” or “ESS”) projects. It also provides engineering, procurement, and construction (EPC) services, with regional teams supporting different phases of development, construction, and operations. CSI has a stated pipeline of 22 GW of solar projects and 19 GWh of storage projects, over and above the 6 GWh of projects already developed, built, and connected to date. CSI has over 13,000 employees and operates on six continents with customers in over 150 countries.

DNV reviewed CSI’s financial results from the first quarter of 2024, and the highlights are as follows:

- Solar module shipments of 6.3 GW, in line with guidance of 6.1 GW to 6.4 GW.
- Net revenues of \$1.3 billion, in line with guidance of \$1.2 billion to \$1.4 billion.
- 19.0% gross margin, at the high end of 17% to 19% guidance range.
- Net income attributable to Canadian Solar of \$12 million or \$0.19 per diluted share.
- Record quarterly delivery by CSE, with revenue topping the total of 2023.

CSI’s energy storage patents cover energy storage cells, modules, packs, liquid cooling systems, fire protection, and testing. Its patent types include invention patents, utility model patents and appearance patents. CSI holds 25 issued or pending patents related to the battery cell product. All these patents are filed in China.

Product Review

The CSI 314 Ah cell (referred to as the ‘Cell’ or ‘Product’) is a prismatic format battery comprising cathode electrodes, anode electrodes, separators, electrolyte, and ancillary components such as an aluminium shell, cell cap, and vent. These elements are standard for a conventional LFP prismatic cell.

CSI tested the cell capacity, C-rate performance, high/low temperature performance, cycle life, and storage life. DNV considers CSI’s cell performance to be in line with similar products in the industry.

As of cell degradation, the degradation curves are made up of real cycling data and predicted data obtained by simulation. At 25°C, the expected energy retention of 71% after 10,000 cycles translates to approximately 27.4 years (assuming one cycle per day). At 45°C, the expected energy retention of 70% after 4,500 cycles translates to approximately 12.33 years (assuming one cycle per day). DNV notes that these expectations are reasonable and in-line with similar cell products in the market.

Safety and Compliance Evaluation

CSI’s 314 Ah cell has obtained following certificates, which make it appropriate to be sold and used in North America.

- UL 1973:2022

- IEC 62619:2022
- UN 38.3
- RoHS
- REACH

CSI's 314 Ah cell has been tested according to the UL 9540A:2019. During the UL 9540A test, the measured hydrogen gas composition was 49.725%, which is within the acceptable range. The cell level UL 9540A test demonstrated evident thermal runaway, which can lead to catastrophic consequences. To ensure safe operation, it is crucial to investigate the thermal runaway characteristics at higher levels, such as battery modules and racks.

CSI conducted safety tests on the 314 Ah cell according to the Chinese standard GB/T 36276-2018, which includes some safety tests that resemble UL 1973 and IEC 62619, such as drop, overcharge, short circuit tests, etc. Nevertheless, several of them were tested under more stringent conditions, e.g., the drop test was performed at a height of 1.5 m while the requirement is 1 m in the UL or IEC standards. The conditions for the overcharge test are also more stringent than the conditions of the overcharge test specified in UL 1973 and IEC 62619. The cells passed these tests without fire or explosion, which DNV finds to be in line with the expectations.

Quality System and Manufacturing Evaluation

DNV performed a review of the manufacturing and quality processes associated with CSI's 314 Ah cells. The cells are manufactured in CSI's manufacturing facility in Yancheng City, China. DNV visited the manufacturing facility on 20th January 2025 to evaluate CSI's quality management system and product manufacturing.

The quality management system of CSI's Yancheng manufacturing facility is established based on ISO 9001:2015 (quality system). The Yancheng manufacturing facility is a newly built and has not obtained the globally recognized certificates as of March 2025. DNV was informed that the development of the quality system in the Yancheng manufacturing facility started in June 2024.

CSI implements quality management throughout the whole production cycle from supplier evaluation, incoming material inspection, manufacturing, and product testing.

CSI's manufacturing facility was founded in July 2023. The registration address is No 3-1, Yongsheng road, Economic Develop Zone, Dafeng District, Yancheng City, Jiangsu Province. At present, there is one production line dedicated to 314 Ah cell production, of which the annual capacity is 3 GWh in total. As of the expansion plan, CSI is going to have another three production lines, delivering the total annual production capacity of 12 GWh.

The cell manufacturing is made up of three phases – electrode preparation, assembly, and testing. The cell production equipment used in CSI's manufacturing facility is highly automated. The production area implements stringent temperature, humidity, and dust control.

DNV was informed that the process verification and production part approval process (PPAP) are not completed. DNV suggested having another visit once these are done.

Overall, DNV looks favourably on the layout of the production area. The equipment maintenance is executed to the clearly defined standard within the organisation. Standard operating procedures (SOP) are available in both hardcopy and electronic formats and placed on the wall of the production area. The quality inspection document, including in-process quality control, manufacturing production monitoring, non-conforming product management, and training are implemented



with high standards. DNV suggests visiting CSI's cell production facility again once the process verification and PPAP processes are completed.

Product Support Evaluation

e-STORAGE uses an in-house software called CSEye for 24/7 remote monitoring, diagnostics, and troubleshooting of their energy storage systems, generating detailed performance reports, and managing spare parts inventory. DNV considers it to be in line with industry expectations.

1 INTRODUCTION

CSI Energy Storage Co.,Ltd (the “Customer” or “CSI”) has engaged DNV China Company Limited (hereinafter “DNV”) to complete a technical due diligence evaluation of CSI’s 314 Ah battery cell. This evaluation is intended to serve as third-party assessment of the CSI’s battery product. DNV reviewed CSI’s product specification, design for functionality and safety, performance, product warranties, and manufacturing capabilities.

DNV is a leading authority on consulting, implementation, research, testing, and certification of solutions for the energy sector. Recognized as a global leader in energy storage consulting, DNV provides strategic advisory services, innovative modeling tools, and independent testing and certification to clients across various sectors of the energy industry. DNV operates as an independent entity without ties to any vendor, investments, affiliations, or financial interest with any equipment or service providers.

1.1 Report scope of work

The primary objective of this report is to assess factors that would affect the final product’s performance and reliability in the field and the company’s ability to deliver and service the products within its stated timeframe. Such factors will include the product design, quality of materials, product performance, regulatory compliance, reliability tests, and the manufacturing and quality control processes. DNV has divided the technology review into several main topic areas for evaluation as illustrated in Figure 1-1.



Figure 1-1 Report Structure

As part of the CSI’s technology bankability review, DNV performed inspections of CSI’s manufacturing plants in Yancheng, China. The objective was to confirm that CSI has the processes in place to deliver the expected quantity and quality of the product for meeting the required standards in reliability and safety.

1.2 Approach

This report represents DNV’s final Independent Engineering review intended for financial institutions, CSI customers, and project developers. DNV is uniquely qualified to conduct this study due to its extensive background and experience in solar, wind, and energy storage independent engineering and technology due diligence work.

DNV's approach to completing the technology review includes three levels of assessment. First, DNV will verify that the product and process claims align with product documentation (e.g., roundtrip efficiency used in models matches the specification sheet), that there is consistency in the preparation of materials (e.g., the nomenclature for the product matches throughout), and that the claimed values are aligned with expectations based on industry norms. Second, DNV will compare the specified values to test data, validating the claims. Depending upon what claims are being assessed, this test data may be at a bench scale, from simulations, from demonstration or pilot sites, or from third-party certifiers. The granularity and rigor of these tests impact the strength of DNV's opinion when comparing the tested results to the claimed characteristics, but typically this information will allow DNV to determine if the system is designed and tested appropriately for the intended application. Third, DNV will review real world or field data. This information will provide confidence in performance over time, under a variety of uncontrollable conditions, and for a statistically meaningful number of systems. At the current maturity of the energy storage industry, DNV is not typically provided with a sufficient amount of field data, nor is there sufficient consistency across the industry, for there to be a single, industry- and financier-accepted definition for a "proven" technology. However, DNV can identify risks and recommend mitigants, based on parallels to other industries.

To perform the assessment, DNV relied on documentation provided by CSI, a factory visit, as well as phone calls with CSI staff associated with the topic areas covered. Further, the following customer meetings were conducted by DNV to align and close the gaps with respect to documentation provided by CSI via Virtual data room.

1.3 Assumptions

This report summarizes the DNV assessment of the technology and relies on the accuracy of the information provided by CSI. CSI has been forthcoming in providing the data that DNV has requested; where data was not provided or was incomplete is noted as such within the report. Within this report, DNV highlights the risk of any missing or incomplete data and reviews and opines on the information that has been provided to date.

This report is based on some information not within the control of DNV. DNV believes that the information provided by CSI is true, correct, and reasonable for the purposes of this report. DNV has not been requested to make an independent analysis or verification of the validity of such information. DNV does not guarantee the accuracy of the data, information, or opinions provided by CSI.

In preparing this report and the opinions presented herein, DNV has made certain assumptions with respect to conditions that may exist, or events that may occur in the future. DNV believes that these assumptions are reasonable for the purposes of this report, but actual events or conditions may cause results to differ materially from forward-looking statements.

2 COMPANY EVALUATION

2.1 Company overview

Canadian Solar Inc. ("CSI") is a vertically integrated solar and energy storage solutions provider. It was founded in 2001, Ontario, Canada. Initially, the company produced portable solar chargers for automobile batteries. Over time, it expanded into manufacturing solar systems for residential and commercial installations. By 2006, CSI went public on the NASDAQ stock exchange, raising capital to support its growth.

CSI, through its subsidiaries, operates globally as a developer of photovoltaic (PV) and battery energy storage system ("BESS" or "ESS") projects. It also provides engineering, procurement, and construction (EPC) services, with regional teams supporting different phases of development, construction, and operations. CSI has a stated pipeline of 22 GW of solar projects and 19 GWh of storage projects, over and above the 6 GWh of projects already developed, built, and connected to date. CSI has over 13,000 employees and operates on six continents with customers in over 150 countries.

Within CSI, the Canadian Solar e-STORAGE (herein referenced as "e-STORAGE" or "CSE") team leverages CSI's organizational strengths to offer turnkey BESS for the utility-scale market. CSE leverages over 50 years of combined storage experience, as well as CSI central procurement strategies. CSE had been deploying utility-scale BESS projects since 2021 under a group known as System Solutions and Energy Storage (SSES) and was rebranded as e-STORAGE in 2023.

CSI has two main lines of business involved in storage projects (with an arm's-length relationship), which are summarized below:

- **Module and Energy Storage:** This is the technology, manufacturing, and EPC arm of CSI. The CSE division leads all aspects of storage technology including design and engineering, energy storage integration, and procurement.
- **Energy Business:** This is the project development arm of CSI focused on solar and storage project development as well as operations and maintenance related to large scale utility projects.

The CSE team offers three types of services, covering both standalone storage and PV + storage solutions: design services, turnkey BESS project development, and BESS system O&M. Design services include system-sizing modelling, integrated power electronics design, and system controls solutions. CSE delivers wrapped turnkey energy storage solutions consisting of containerized battery modules, as well as supporting equipment. CSE also offers warranties and performance guarantees for their systems. O&M services offered include, but are not limited to, site monitoring, periodic routine reporting, preventive and corrective maintenance, as well as warranty and spare parts management. DNV reviewed a list of reference projects completed by CSE. The list included 14 large-scale BESS projects totaling 862 MWac, and 2,804 MWhac that are deployed and operational, as well as 25 BESS projects totaling 2,447 MWac and 5,786 MWhac that are currently under construction. CSE has deployed more than 2.7 GWh of battery energy storage solutions across the United States, Canada, the United Kingdom, and China.

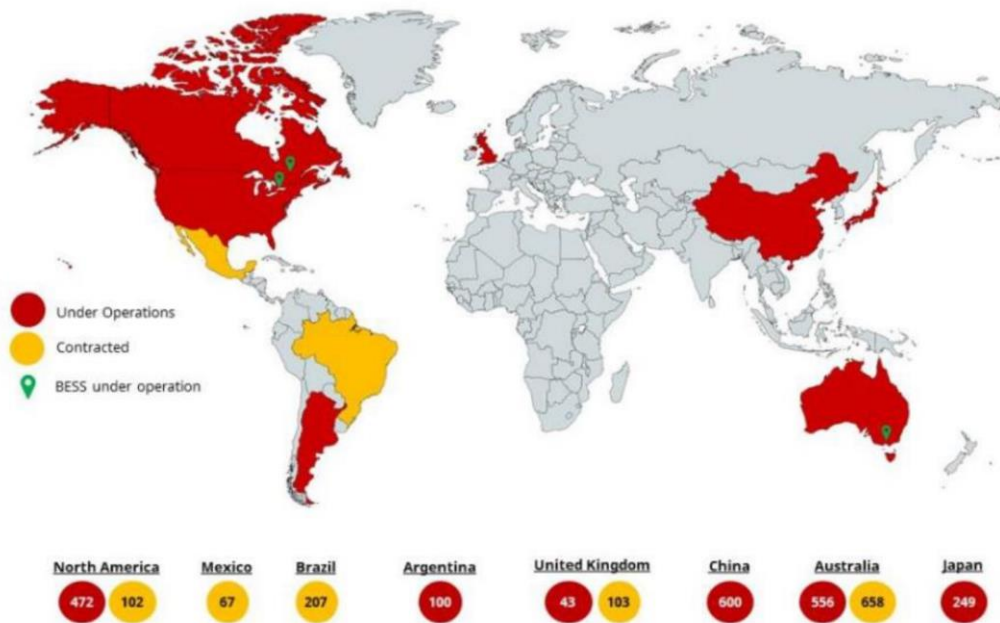


Figure 2-1 CSI global presence

In July 2020, Canadian Solar announced its plan to segregate and publicly list its Module and System Solutions (“MSS”) DNV recognizes the CSI organization and its subsidiaries as an industry leading organization. DNV notes that CSE is backed by the CSI organization and is integrated with CSI’s vast resources of executing utility scale projects globally which has added to the CSE team’s experience in integration of BESS into their project pipeline.

2.2 Company financials and sales revenues

DNV reviewed CSI’s financial results from the first quarter of 2024, and the highlights are as follows:

- Solar module shipments of 6.3 GW, in line with guidance of 6.1 GW to 6.4 GW.
- Net revenues of \$1.3 billion, in line with guidance of \$1.2 billion to \$1.4 billion.
- 19.0% gross margin, at the high end of 17% to 19% guidance range.
- Net income attributable to Canadian Solar of \$12 million or \$0.19 per diluted share.
- Record quarterly delivery by CSE, with revenue topping the total of 2023.

Gross profit in the first quarter of 2024 was \$253 million, up 18% quarter-over-quarter and down 21% year-over-year. Total operating expenses in the first quarter of 2024 were \$204 million, compared to \$213 million in the fourth quarter of 2023 and \$172 million in the first quarter of 2023. DNV views these financial trends observed positively.

2.3 Stationary energy storage product history

In early 2021, CSE began the development of its proprietary utility-scale BESS called SolBank. The SolBank product is a liquid cooled, fully integrated energy storage system, which can be configured as either an ac coupled, or dc coupled architecture.

It utilizes lithium iron phosphate (LFP) battery cells manufactured by various cell suppliers including EVE Energy Co., Ltd. (EVE) and Xiamen Hithium New Energy Technology Co., Ltd. (Hithium). CSI also has in-house manufactured LFP cells which are used in their SolBank products, which is the cell product under review in this report.

CSE has shared a list of deployed/operational, under construction, pre-construction and under contracting projects with DNV. Summary of the important data is listed in Table 2-1. Starting from 2023, all projects have adopted SolBank. This includes projects that are currently in the contracting phase, which encompasses agreements for SolBank versions 1.0, 2.0, and 3.0. The system has a grand total energy of 5,366 MW AC and 13,596 MWh AC usable energy storage capacity and nominal capacity of 17,199 MWh DC.

Table 2-1 CSI's Reference Project List

Type	MW AC Usable	MWh AC Usable	MWh DC Nominal	COD	Locations	Contract type
Deployed/operational	862	2,804	3,426	2021-2023	USA, UK, China	Turnkey EPC, BESS Supply
Under construction	2,447	5,786	7,253	2023-2025	USA, UK, China, Australia	Turnkey EPC, BESS Supply
Pre-construction	980	2,355	2,945	2025	USA, Canada, Taiwan	Turnkey EPC, BESS Supply
Under contracting	1,077	2,651	3,575	2024-2025	USA, Canada, UK, Australia, China, Chile	Turnkey EPC, BESS Supply

2.4 Intellectual Property

CSI's energy storage patents cover energy storage cells, modules, packs, liquid cooling systems, fire protection, and testing. Its patent types include invention patents, utility model patents and appearance patents. CSI provided DNV with a spreadsheet detailing 25 issued or pending patents related to the battery cell product. A listing is found in Table 2-2 below. DNV notes that all these 25 patents are registered in China. CSI has not provided any patent filed in US.

Table 2-2 CSI battery cell patents

No	Patent Name	Type	Patent number
1	A pole packaging method and cover plate for lithium battery	Utility model	202222598491.7
2	A pole packaging method and a battery cover plate	Utility model	202322309972.6
3	A liquid injection hole sealing mechanism	Utility model	202322240121.0
4	A forming nail with hydrophobic and breathable function	Utility model	202322930373.6
5	Double-layer coated graphite anode material and preparation method	Utility model	202323037134.4
6	A positive electrode lithium supplement additive co-doped with lithium ferrite by Al and Co	Invention	202311728445.7

7	A method for improving the alkali resistance of lithium battery electrodes	Invention	202311842943.4
8	Preparation method of fluorosilicate-modified lithium ferrite and its application	Invention	202410617344.0
9	Preparation method of lithium ferrite with core-shell structure and application	Invention	202410617343.6
10	Blade battery with lithium supplement function and preparation method	Invention	202410945643.7
11	A mylar membrane with the function of slow-release lithium supplementation	Utility model	202421437212.1
12	Application of a new type of functionalized composite separator film in lithium-ion batteries	Invention	202411249703.8
13	Preparation method of continuous thermal composite lamination	Utility model	202421913765.X
14	Preparation method of pre-lithiated thin film	Invention	202411041999.4
15	A 3D printed pre-lithiated film	Invention	202411042004.6
16	The appearance of lithium batteries	Appearance	202430454715.9
17	Blade battery with high charge-discharge energy efficiency and preparation method	Invention	202411223558.6
18	A modular energy storage system based on a 20-foot container and a single rectangular aluminum shell battery	Invention + Utility model	202423324018.5
19	A method for improving the cutting burr of the winding pole piece by UV spraying of lithium battery	Utility model	202422219358.5
20	Methods to improve the wetting rate of the electrolyte, battery and battery preparation methods	Utility model	202410607015.8
21	An application method of UV spraying on cathode insulation coating	Utility model	202422551180.4
22	A nickel-plated copper foil surface treatment system for lithium batteries	Utility model	202422553151.1
23	A refillable battery cover structure	Utility model	202422807707.5
24	A battery with a built-in miniature sensor or sampling line	Utility model	202422820556.7
25	A lithium battery cover that can be refilled twice or multiple times	Utility model	202422714312.0

DNV does not act as a patent attorney and does not comment regarding whether the client's technology violates others' patents. DNV observes the magnitude of the patent effort and comments on the company's IP strategy, when applicable. Furthermore, DNV did not review CSI's patents and their use regarding their product.

3 PRODUCT REVIEW

This chapter intends to review the product design, technical specifications, and performance characteristics. The key performance tests include C-rate test, high and low temperature test, cycle life, and storage life tests. DNV evaluates CSI's cell product by reviewing documents and test results provided by CSI [2].

3.1 Product overview and specifications

The CSI 314 Ah cell (referred to as the 'Cell' or 'Product') is a prismatic format battery comprising cathode electrodes, anode electrodes, separators, electrolyte, and ancillary components such as an aluminium shell, cell cap, and vent. These elements are standard for a conventional LFP prismatic cell.

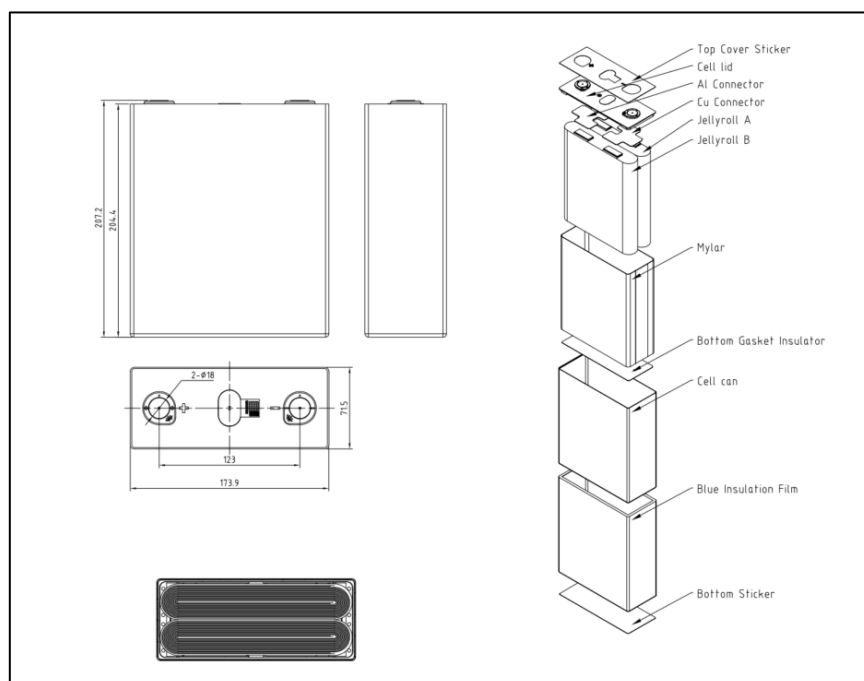


Figure 3-1 Product design and drawing of CSI's 314 Ah cell

Table 3-1 outlines the product specifications of CSI's 314 Ah prismatic cell.

Table 3-1 Technical specifications of CSI's 314 Ah cell

Parameter	Specification
Cell type/chemistry	Type: Prismatic Chemistry: LFP
Cell model	CSI314
Nominal capacity	314 Ah
Nominal energy	1004.8 Wh
Operating voltage range	2.5 – 3.65 V (T>0°C) 2.0 – 3.65 V (T≤0°C)

Nominal voltage	3.2 V
Impedance (@1 kHz)	≤0.25 mΩ
Rated power	502.4 W (0.5P)
Maximum charge current	314 A
Operating temperature range	0°C to 60°C (charging) -20°C to 60°C (discharging)
Optimal operating temperature range	15°C to 35°C
Storage conditions	-20°C to 45°C, 50% SOC
Humidity range	< 85% RH, no condensation
Cell dimensions (W x L x H)	71.8 ± 0.8 mm x 173.7 ± 0.5 mm x 204.4 ± 0.5 mm
Mass	5.66 ± 0.2 kg
Gravimetric energy density	177.53 Wh/kg
Cycle performance	12,000 cycles@60% SOH
Capacity@55°C	≥ 314 Ah
Capacity@-20°C	≥ 220 Ah

DNV finds the specifications of CSI's 314 Ah cell to be aligned with expectations.

3.2 Performance evaluation

3.2.1 Capacity

CSI measures the Cell capacity at 5°C, 25°C, and 45°C. The Cell is charged by 0.5P constant power to 3.65V and discharged to 2.5V with 10 minutes rest between each charge and discharge. The pass criteria of the energy efficiency are 94.5% for 25°C and 45°C, and 80% for 5°C. The test results are outlined in Table 3-2 [3].

Table 3-2 Capacity results of CSI's 314 Ah cell

Cell No.	Temperature	Charge capacity/ Ah	Discharge capacity/Ah	Charge energy/Wh	Discharge energy/Wh	Energy efficiency
1	25°C	333.56	335.12	1129.24	1067.14	94.5%
2	25°C	334.46	335.97	1131.50	1070.33	94.59%
1	45°C	336.67	342.73	1135.10	1101.07	97%
2	45°C	337.08	343.09	1139.11	1098.00	96.88%
1	5°C	316.48	300.31	1091.10	929.04	84.29%
2	5°C	319.07	304.63	1098.35	944.48	85.99%

Figure 3-2 shows charge and discharge curves of CSI's 314 Ah cell at 5°C, 25°C, and 45°C. Under 25°C and 45°C, the Cell exhibits typical charge and discharge plateau around 3.1 V to 3.3 V, which signals typical electrochemical behaviors and minimum side reactions during charging and discharging. The discharge capacity of the cell exceeds the rated capacity under these temperatures. DNV notes that the actual cell capacity is expected to be higher than its rated capacity. During the cell manufacturing process, cells are graded based on the actual capacity. Under 5°C, the discharge capacity is slightly

lower than its rated capacity, which is a typical characteristic of an LFP cell. DNV looks favourably on the capacity results, which meet design criteria.

DNV notes that the discharge capacity is not typically higher than the charge capacity. This anomaly should be clarified by CSI to ensure there are no underlying issues with the cell's performance or measurement accuracy.

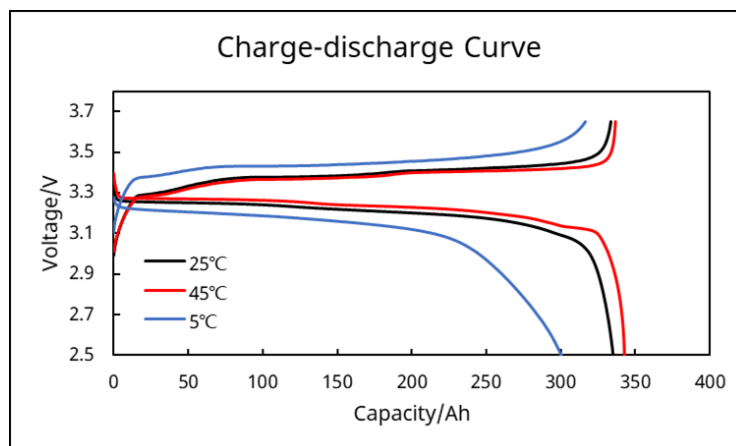


Figure 3-2 Charge and discharge curves of CSI's 314 Ah cell

3.2.2 C-rate performance

C-rate indicates how quickly the cell is charged from 0% state of charge (SOC) to 100% SOC or discharged from 100% SOC to 0% SOC. For instance, discharging a cell by 0.5C indicates that it takes two hours to fully charge the cell from its fully discharged state. DNV notes that using a cell at high C-rate can lead to adverse effects over time.

For cells designed for ESS applications, cell manufacturers more commonly characterise the cells by using constant power rate (P-rate).

CSI's 314 Ah cell is tested under 0.5P and 1.0P, and combination of both. The test procedures are summarised as follow.

- 0.5P: 25°C; 0.5P charge to 3.65 V; 10 minutes rest; 0.5P discharge to 2.5 V
- 1.0P: 25°C; 1.0P charge to 3.65 V; 10 minutes rest; 1.0P discharge to 2.5 V
- 1.0P/0.5P: 25°C; 1.0P charge to 3.65 V; 10 minutes rest; 0.5P to 3.65 V; 10 minutes rest; 1.0P discharge to 2.5 V; 10 minutes rest; 0.5P discharge to 2.5 V

The rate performance test results are summarised in Table 3-3 [3].

Table 3-3 Rate performance results of CSI's 314 Ah cell

Cell No.	1			2		
Rate	0.5P	1.0P/0.5P	1.0P	0.5P	1.0P/0.5P	1.0P
Charge energy (Wh)	1130.22	1141.30	1151.34	1135.43	1149.50	1159.73
Discharge energy (Wh)	1070.99	1057.05	1059.65	1075.56	1062.23	1056.98
Energy efficiency	94.76%	92.62%	91.34%	94.73%	92.41%	91.14%

DNV notes that the discharge capacity of the Cell exceeds the rated discharge capacity. Moreover, the energy efficiency exceeds the criteria, which is above 90%.

DNV also notes that under 1.0P, the charge energy is higher than that tested under 0.5P, which is caused by the heat generated by the cell at high charge rate. However, the discharge energy is lower than that tested under 1.0P, which leads to lower energy efficiency. DNV notes that such characteristics are typical for cell products of the same category.

3.2.3 High and low temperature

High and low temperature test intends to find out the operating temperature range of a cell product and the optimal temperature range. Typically, the optimal temperature range of an LFP chemistry is 20°C - 30°C. If the temperature is too high, the cell capacity is higher for short term yet accelerates cell degradation. If the temperature is too low, the charge and discharge reactions become kinetically unfavourable, which causes capacity loss or side reactions such as lithium plating, which can result to internal short circuit.

CSI tested its 314 Ah cell under various temperatures across -20°C to 55°C by using 0.5P. The rest time between charge and discharge is 10 minutes. The cell is charged to 3.65 V at all temperatures, the discharge cut-off voltages range from 2.5 V (when temperature is above 0°C) to 2.0 V (when temperature is below 0°C). Table 3-4 summarises the high and low temperature test results of CSI's 314 Ah cell [3].

Table 3-4 Temperature performance of CSI's 314 Ah cell

Cell No.	Temperature	Charge capacity (Ah)	Discharge capacity (Ah)	Charge energy (Wh)	Discharge energy (Wh)	Energy efficiency
1	25°C	333.56	335.12	1,129.24	1,067.14	94.50%
2	25°C	334.46	335.97	1,131.50	1,074.33	94.59%
1	45°C	336.67	342.73	1,135.10	1,101.07	97.00%
2	45°C	337.08	343.09	1,139.11	1,098.00	96.88%
1	55°C	340.73	345.00	1,143.66	1,108.75	96.95%
2	55°C	340.38	344.00	1,141.56	1,103.90	96.70%
1	5°C	316.48	300.31	1,091.10	929.04	84.29%
2	5°C	319.07	304.63	1,098.35	944.48	85.99%
1	-20°C	/	319.82	/	885.09	/

Cell No.	Temperature	Charge capacity (Ah)	Discharge capacity (Ah)	Charge energy (Wh)	Discharge energy (Wh)	Energy efficiency
2	-20°C	/	323.40	/	907.31	/

The discharge capacity exceeds the rated capacity when the temperature is above 5°C, which is a typical characteristic of LFP cells. However, it is important to note that high temperature conditions accelerate the long-term degradation of Li-ion cells.

CSI tested the cell at -20°C to verify the claimed operating temperature range (-20°C to 60°C according to Table 3-1). At this temperature, the cell voltage becomes low due to high internal resistance of the cell. When the cell is discharged, it generates significant amount of heat, which leads to increase of kinetic energy and brings the cell voltage up. The cell voltage then decreases as discharge continues. DNV notes that such low-temperature behavior is typical for an LFP cell. DNV notes that the operating temperature range for charging is between 0°C to 60°C, therefore the charge capacity at 20°C in Table 3-1 is not applicable.

DNV notes that the discharge capacity is not typically higher than the charge capacity. CSI shall clarify these results further.

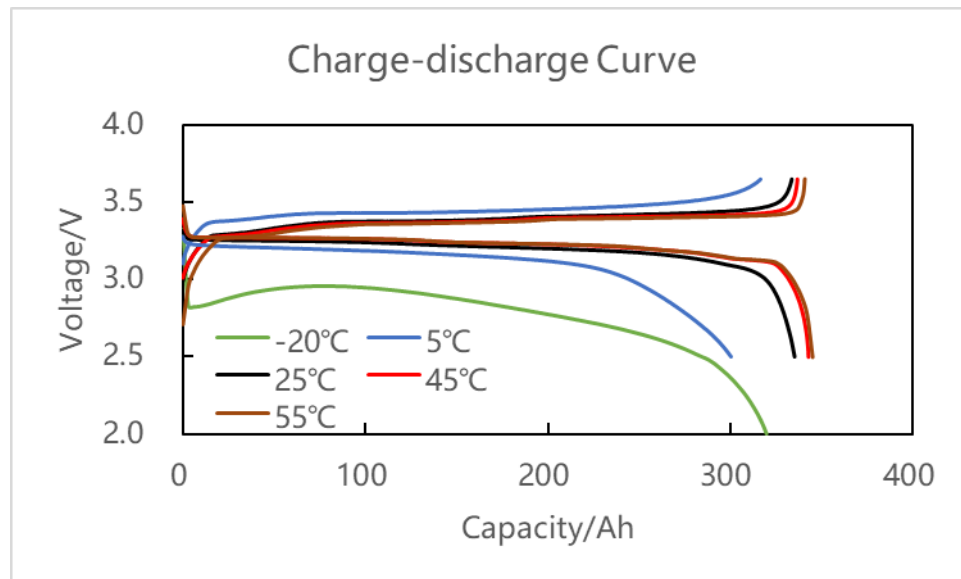


Figure 3-3 Charge and discharge curves of CSI's 314 Ah cell in various temperatures

3.2.4 Cycle life performance

Cycle life performance, or degradation, is a measure of cell's product life under certain operating conditions. The indicator of the cycle life performance is the capacity retention, which is calculated as the ratio of discharge capacity of any cycle to the initial discharge capacity at the fresh state. This measure is often known as the state of health (SOH).

CSI conducted the cycle life test at 25°C and 45°C by 0.5P charge and discharge rates. The rest time is 30 minutes for the 25°C test and 10 minutes for the 45°C test. Figure 3-4 shows degradation curves of CSI's 314 Ah cell [3].

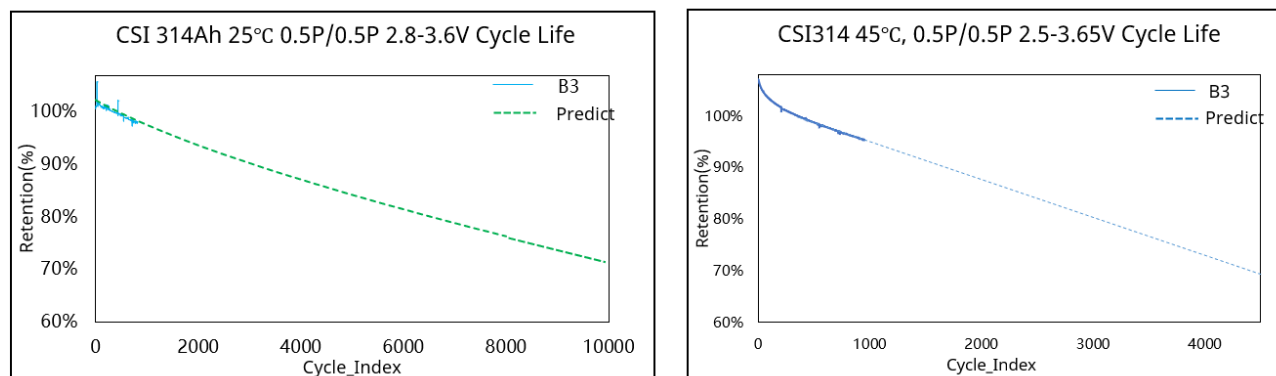


Figure 3-4 Degradation curves of CSI's 314 Ah cell at 25°C and 45°C

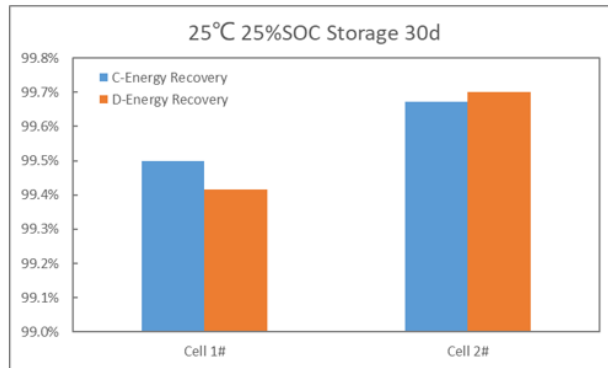
The degradation curves are made up of real cycling data (blue solid lines) and predicted data obtained by simulation (dash lines). At 25°C, the expected energy retention of 71% after 10,000 cycles translates to approximately 27.4 years (assuming one cycle per day). At 45°C, the expected energy retention of 70% after 4,500 cycles translates to approximately 12.33 years (assuming one cycle per day). DNV notes that these expectations are reasonable and in-line with similar cell products in the market. DNV is unable to comment on the reliability of the prediction, which require verification periodically when more actual data becomes available.

DNV notes that the cycle performance claims in the product technical specifications are intended for reference purposes only. In real-world applications, degradation can vary significantly due to several factors, including C-rates, ambient temperature, average SOC, depth of discharge, SOC swing, and other operational conditions.

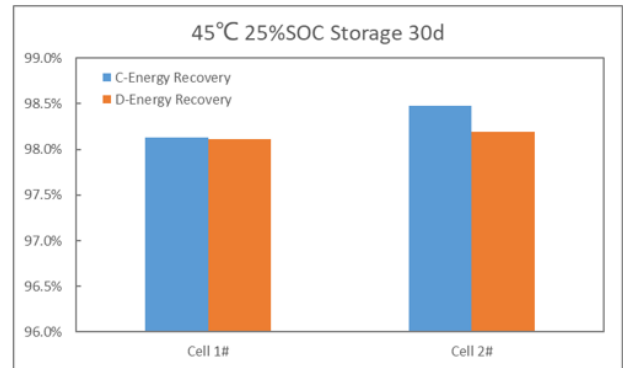
3.2.5 Storage and recovery

CSI conducted storage tests of the cell for 30 days under two conditions – 1) 45°C at 25% SOC, and 2) 25°C at 25% SOC. The major indicators of the storage test are residual energy, which is the remaining cell capacity after storage, and energy recovery, which is defined by the ratio of charge/discharge capacity after storage to that of before storage. The pass criteria are both residual energy and recovery energy to be greater than 95%.

Figure 3-5 shows the storage and recovery results of CSI's 314 Ah cells [3].



25°C 25%SOC 30d				
Cell No.	1#		2#	
	0d	30d	0d	30d
C-Energy(Wh)	1143.89	1138.17	1133.54	1129.84
DC-Energy(Wh)	1080.53	1074.22	1072.54	1069.34
C-Energy Recovery/%	99.50%		99.67%	
DC-Energy Recovery/%	99.42%		99.70%	



45°C 25%SOC 30d				
Cell No.	1#		2#	
	0d	30d	0d	30d
C-Energy(Wh)	1136.12	1114.89	1140.47	1123.08
DC-Energy(Wh)	1074.98	1054.72	1079.62	1060.12
C-Energy Recovery/%	98.13%		98.48%	
DC-Energy Recovery/%	98.12%		98.19%	

Figure 3-5 Storage and recovery test results of CSI's 314 Ah cell

The storage and recovery performance of CSI's 314 Ah is aligned with typical performance of similar cell products in the market. For the minimum loss due to the storage, DNV recommends cell users putting cells in storage under recommended temperature and SOC as per product technical specification document, as well as recharging the cell at the recommended interval.

4 SAFETY AND COMPLIANCE EVALUATION

This chapter summarises the standards applicable to the Cell. In this section, DNV reviews the tests that the product must undergo to pass various standards, including the methods of test, the conditions, and the outcomes required.

Safety is a critical design and operational aspect of energy storage devices. The safety of an energy storage system builds up from the battery cell and is relevant to every stage of the product's life cycle based on code requirements and best practices.

DNV considers certifications to codes and standards to be minimum requirements. Since codes and standards do not necessarily match up to best practices, DNV expects a robust safety program to go beyond the basic requirements.

Several standards developed by Underwriters' Laboratories (UL), the United Nations (UN), the Institute of Electrical and Electronics Engineers (IEEE), and the International Electrotechnical Commission (IEC) generally demonstrate the minimum safety considerations associated with the design and transportation of battery energy storage components and systems.

4.1 Regulatory Compliance Evaluation

CSI's 314 Ah cell is designed to comply with standards generally accepted to demonstrate minimum safety considerations in the system's design for the installations in North America, Europe, and Australia. These standards include Underwriters Laboratories (UL) and International Electrotechnical Commission (IEC) standards, as well as UL and UN testing. A list of key standards gathered across several documents is provided in Table 4-1.

Table 4-1 Standard and test list

Standard and Test	Description	Certification Status	Issuing Agency
UL 1973:2022	Standard for Batteries for Use in Stationary and Motive Auxiliary Power Applications	The cell model CSI314 obtains the UL1973 certificate on 12 th June 2024 [4].	TUV Rheinland
UL 9540A:2019	Test Method for Evaluating Thermal Runaway Fire Propagation in Battery Energy Storage Systems	The cell model CSI314 obtained the UL9540A test report on 9 th July 2024 [5].	TUV Rheinland
IEC 62619:2022	Safety requirements for secondary lithium cells and batteries for use in industrial applications	The cell model CSI314 obtains the IEC62619 certificate issued on 3 rd July 2024 [6].	TUV Rheinland
UN 38.3	Recommendations on the Transport of Dangerous Goods, Manual of Tests and Criteria, Section 38.3	The cell model CSI314 obtains the UN38.3 test report on 28 th June 2024 [7].	CVC ¹
RoHS	Restriction of Hazardous Substances Directive	The cell model CSI314 obtains the RoHS test report on 11 th June 2024 [8].	TUV Rheinland
REACH	Registration, Evaluation, Authorisation and Restriction of Chemicals	The cell model CSI314 obtains the REACH test report on 11 th June 2024 [9].	TUV Rheinland

¹ CVC Testing Technology Co.,Ltd.

4.2 UL 9540A testing

UL 9540A testing is a destructive test method used to evaluate the thermal runaway impacts in a BESS and gather data to assist in assessing or developing mitigation measures for the failure event, propagation of the failure, or consequences of an event, such as an explosion or fire. It is currently considered the most appropriate published methodology to provide comprehensive, consistent, and reliable third-party data for battery failure testing.

CSI tested its cell based on the latest 4th edition of the UL 9540A test methodology. Table 4-2 outlines the key test results of UL 9540A test on CSI's 314 Ah cell.

Table 4-2 UL 9540A cell level test results

Test Parameter	Data Collected
Thermal Runaway Methodology	External heating at 4°C/min to 7°C/min up to thermal ramp
Average Cell Gas Venting Temperature	167.4°C
Average Thermal Runaway Onset Temperature	238.5°C
Venting Gas Volume	180.7 L
Gas Composition	CO 13.898%, CO ₂ 26.826%, H ₂ 49.725%, hydrocarbons 9.551%, etc.
Lower Flammability Limit at Ambient Temperature	8.3%
Lower Flammability Limit at Venting Temperature	7.3%
Max. Explosion Pressure (P _{max})	0.76 MPa
Burning Velocity (S _u)	0.973 m/s

Test method and deviations: DNV did not identify deviations from the test method described in UL 9540A. The cell level UL 9540A report outlines the testing method and results in a manner that is mainly consistent with the requirements of UL 9540A 4th edition, section 7.

Venting and thermal runaway temperatures: The cell venting temperature and thermal runaway temperature were 167.4°C and 238.5 °C, respectively. The cells displayed a difference of roughly 70 °C between the temperature at cell venting and thermal runaway event which DNV views favorable. This large temperature difference between venting and thermal runaway may provide enough time for safety systems to detect and respond to thermal events

Gas composition and volumes: During the UL 9540A test, the measured hydrogen gas composition was 49.725%, which is within the acceptable range. The cell level UL 9540A test demonstrated evident thermal runaway, which can lead to catastrophic consequences. To ensure safe operation, it is crucial to investigate the thermal runaway characteristics at higher levels, such as battery modules and racks. Therefore, the UL 9540A test must also be performed at the module level where the CSI's 314 Ah cells are used.

Performance criteria: DNV notes that the UL 9540A test method stipulates that the cell level test should meet the following two performance criteria: thermal runaway should not be induced, and off-gassing event should not produce flammable gases. Since flammable gases were produced, the cell level test did not meet the performance criteria. Hence DNV recommends that the battery modules utilizing this cell, shall be subjected to UL 9540A module level test

4.3 UL 1973

CSI's 314 Ah cell complies with the requirements as per UL 1973 standards. The tests include a short circuit test, cell impact test, drop impact test, heating test, overcharge test, forced discharge test, and projectile test. The results show that the Cell sample remained intact (i.e., it did not vent, leak, rupture, catch on fire, or explode). No projectiles and cells caught fire without explosion during a projectile test.

Page 1

Certificate

Certificate no.	CU 72405509 0001
------------------------	------------------

License Holder: CSI Energy Storage Co., Ltd. No.348 Lushan Road, SND, Suzhou, 215000 Jiangsu P.R. China	Manufacturing Plant: CSI Energy Storage Technology (Dafeng) Co., Ltd. No.3,Yong Sheng Road, Economic Development Zone, Da Feng District, Yan Cheng City, 224100 Jiangsu P.R. China
---	--

Report Number: CN24XEVJ 001	Client Reference: Xiaowei Lu
Certification acc. to: ANSI/CAN/UL 1973:2022	

Product Information

Certified Product: (Rechargeable Li-ion Cell)	
Model Designation: CSI314	
Rated Capacity [Ah] : 314	
Nominal voltage [V] : 3.2	
Other Data : See Appendix	

Technical Data:

Remarks:

Appendix: 1, 1-104



C U S

Date of issue: 2024-06-12
 (yr/mo/day)

TÜV Rheinland of North America, Inc.
 400 Beaver Brook Rd, Boxborough, MA 01719
 Tel +1 (978) 266 9500, Fax +1 (978) 266-9992

www.tuv.com



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Figure 4-1 CSI 314 Ah cell UL 1973 certificate

4.4 IEC 62619

The IEC 62619:2022 standard provides requirements on safety aspects associated with using, inspecting, maintaining, and disposing of cells and batteries used in industrial applications, including stationary applications. This certification includes safety tests such as short circuit, drop, overcharging, forced discharging, thermal abuse, and impact testing.

CSI has obtained IEC 62619:2022 certificate for the 314 Ah cell. In the test report, there was no fire or explosion observed during the test.

		Ref. Certif. No. JPTUV-161351
IEC SYSTEM FOR MUTUAL RECOGNITION OF TEST CERTIFICATES FOR ELECTRICAL EQUIPMENT (IECEE) CB SCHEME		
CB TEST CERTIFICATE		
Product	Rechargeable Li-Ion Cell	
Name and address of the applicant	CSI Energy Storage Co., Ltd. No.348 Lushan Road, SND, Suzhou, 215000 Jiangsu P.R. China	
Name and address of the manufacturer	CSI Energy Storage Co., Ltd. No.348 Lushan Road, SND, Suzhou, 215000 Jiangsu P.R. China	
Name and address of the factory	CSI Battery Technology (Dafeng) Co., Ltd No.3-1, Yongsheng road, economic development zone, Dafeng district, Yancheng city, Jiangsu P.R. China Note: When more than one factory, please report on page 2	
Ratings and principal characteristics	314Ah, 3.2V	
Trademark / Brand (if any)	CanadianSolar (logo)	
Customer's Testing Facility (CTF) Stage used	N/A	
Model / Type Ref.	CSI314	
Additional information (if necessary may also be reported on page 2)	Detail information refer to test report CN244422 001	
A sample of the product was tested and found to be in conformity with	IEC 62619:2022	
As shown in the Test Report Ref. No. which forms part of this Certificate	CN244422 001	
This CB Test Certificate is issued by the National Certification Body		
 TÜVRheinland® Date: 2024-07-03	TÜV Rheinland Japan Ltd. 4-25-2 Kita-Yamata, Tsuzuki-ku Yokohama 224-0021, Japan Mail: info@jpn.tuv.com Signature:  A. Chen	

Figure 4-2 CSI 314 Ah cell IEC 62619 certificate

4.5 UN 38.3

UN 38.3 requires several tests to ensure the relative safety of batteries and cells during transportation. UN 38.3 safety tests include an altitude simulation test, a thermal test, a vibration test, a shock test, a short circuit test, an impact/crush test, and a forced discharge test. DNV notes that CSI's 314 Ah cell has passed the required tests for UN 38.3 with no leakage, venting, disassembly, rupture, or fire.

4.6 Safety tests

Table 4-3 outlines the safety tests which CSI's 314 Ah cell has undergone and passed.

Table 4-3 Summary of safety test and results

Test	Test conditions	Observations	Results
Overcharge	100% SOC, 1.0C charge to 1.5 * Vmax or 1 hour duration time, inspect for one (1) hour.	No fire and no explosion	Pass
Overdischarge	100% SOC, 1.0C discharge to 0V or 90 minutes duration time, inspect for one (1) hour.	No fire and no explosion	Pass
Short circuit	100% SOC, resistance of external short circuit $\leq 5 \text{ m}\Omega$, duration time ten (10) minutes, inspect for one (1) hour.	No fire and no explosion	Pass
Crush	100% SOC, 75 mm radius crush tool, crush speed 5 mm/s, end with zero (0) V or 30% deformation or 13 kN crush force, inspect for one (1) hour.	No fire and no explosion	Pass
Drop	100% SOC, drop from 1.5 m height to the concrete floor, inspect for one (1) hour.	No fire and no explosion	Pass
Low pressure	100% SOC, rest for six (6) hours under 11.6 kPa pressure, inspect for one (1) hour.	No fire, no explosion, and no electrolyte leak	Pass
Heating	100% SOC, 5°C/min heat to 130°C, keep for 30 minutes, inspect for one (1) hour.	No fire and no explosion	Pass
Thermal runaway	100% SOC, heat the cell until thermal runaway.	No fire and no explosion	Pass

All the tests refer to Chinese standard GB/T 36276-2018, which includes some safety tests, resembling UL 1973 and IEC 62619, such as drop, overcharge, short circuit tests, etc. Nevertheless, several of them were tested under more stringent conditions, e.g., the drop test was performed at a height of 1.5 m while the requirement is 1 m in the UL or IEC standards. The conditions for the overcharge test are also more stringent than the conditions of the overcharge test specified in UL 1973 and IEC 62619. The cells passed these tests without fire or explosion.

5 QUALITY SYSTEM AND MANUFACTURING REVIEW

DNV performed a review of the manufacturing and quality processes associated with CSI's 314 Ah cells. The cells are manufactured in CSI's manufacturing facility in Yancheng City, China. DNV visited the manufacturing facility on 20th January 2025 to evaluate CSI's quality management system and product manufacturing.

5.1 Quality management system evaluation

The quality management system of CSI's Yancheng manufacturing facility is established based on ISO 9001:2015 (quality system). The Yancheng manufacturing facility is a newly built and has not obtained the globally recognised certificates as of March 2025. DNV was informed that the development of the quality system in the Yancheng manufacturing facility started in June 2024.

CSI expected to obtain ISO 9001:2015 (quality system), ISO 14001:2015 (environmental system), and ISO 45001:2018 (occupational health and safety system) in April 2025.

CSI implements quality management throughout the whole production cycle from supplier evaluation, incoming material inspection, manufacturing, and product testing. CSI's quality management system scope, depicted in Figure 5-1, is thorough and in line with industry standards.



Figure 5-1 CSI's quality management scope

5.1.1 Supplier management

CSI's supplier quality management is internally audited as per ISO 9001:2015. CSI has developed a 'Supplier Management Procedure' and 'Supplier Evaluation Procedure'. For most critical raw materials such as electrode materials, electrolyte, and separator, the suppliers are subject to mandatory annual evaluation. The key evaluation matrices in the Supplier Evaluation Procedure include:

- Project management
- Planning of the product and process development
- Execution of the product and process development
- Raw material supplier management
- Process analysis and production
- Customer satisfaction

CSI reviewed the 'Supplier Performance Evaluation Report', which is adequate and in line with the industry standard. Figure 5-2 shows the process flow chart of new supplier screening and new material development. DNV finds the processes aligned with industry practices.

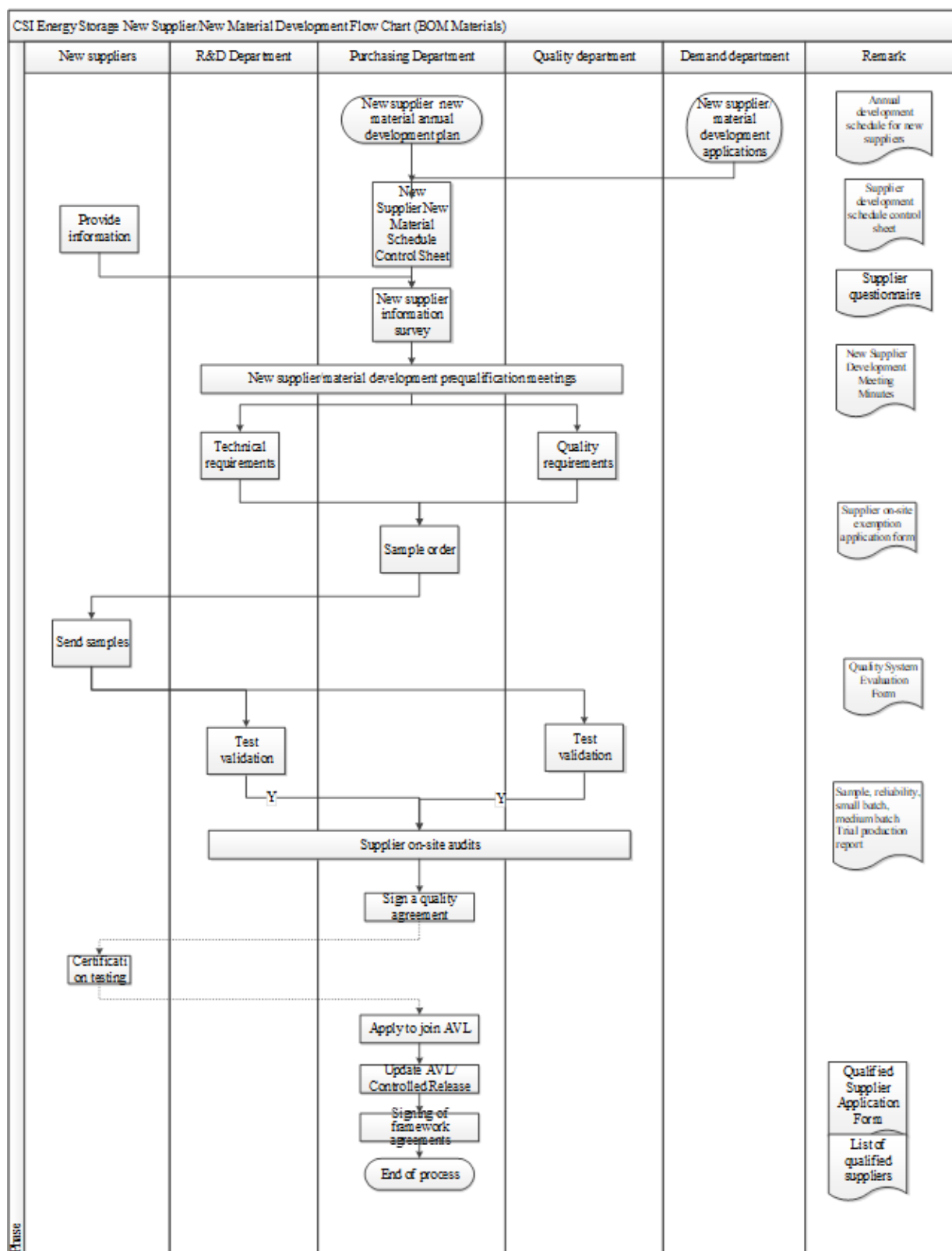


Figure 5-2 Supplier management procedure process flow chart

5.1.2 Incoming material inspection

CSI developed incoming material inspection specifications to evaluate the materials before entering the production process. The incoming quality control ensures the products are built with components from qualified suppliers and meet the technical requirements.

The quality of raw materials is controlled by the generation of IQC reports, where the sample batch number, inspection items, pass criteria, and inspection results are demonstrated. Once the incoming material inspection is passed, the whole batch in which the samples are tested are authorised to be released to the warehouse and the production line. If non-conforming materials are found, the whole batch of the material will be given a red label as shown in Figure 5-3, where the batch number, component name, supplier name, and reasons of failure are recorded. These non-conforming materials are pending to further analysis and handled in accordance with CSI's non-conforming material handling procedures. The communication between the IQC and warehouse operators is achieved via the Warehouse Management System (WMS), which is a computational tool commonly used in the manufacturing industry.



Figure 5-3 Non-conforming material and the red label

With respect to the IQC test capabilities, CSI has an in-house test center which is capable of comprehensive inspection such as part mechanical inspection, structural inspection, electrical characteristic inspection, and chemical property characterisation.

DNV looks favourably on CSI's incoming material quality control practices and the IQC testing capability, which are found in line with the industry common practices.



Figure 5-4 Battery cell incoming material inspection lab

5.1.3 Manufacturing quality control

CSI's manufacturing quality control processes includes the following items:

- Environmental control – the production areas implement temperature and humidity control, which is a common practice for battery manufacturing. In addition, the dust control is implemented in the production area overall as well as some critical production steps, e.g. the dust removal during slurry mixing is achieved by magnetic bar and filtration.
- In-process quality control (IPQC) – during the cell production, some key parameters associated with the product quality are inspected with defined sampling frequencies. These inspections include slurry viscosity, electrode thickness, electrode overhang, etc.

- The production equipment and logistic line are automated and a detailed equipment maintenance plans are in place. CSI implements whole equipment life cycle management, which includes planning, design, procurement, regular inspection and maintenance, upgrading, and recycle.
- Operator training and assessment ensuring manufacturing personnel conduct in consistent manner in their workplace.
- CSI has procedures to manage engineering change. Any change in material supplier, equipment change, manufacturing parameter is required to be filled in an engineering change request (ECR) form, which must be reviewed and approved by the management before the change can be implemented.

5.2 Manufacturing evaluation

5.2.1 Manufacturing facility overview

CSI's manufacturing facility was founded in July 2023. The registration address is No 3-1, Yongsheng road, Economic Develop Zone, Dafeng District, Yancheng City, Jiangsu Province. At present, there is one production line dedicated to 314 Ah cell production, of which the annual capacity is 3 GWh in total. As of the expansion plan, CSI is going to have another three production lines, delivering the total annual production capacity of 12 GWh.



Figure 5-5 Aerial view of CSI's cell manufacturing facility

Figure 5-6 depicts the manufacturing facility layout. The flow of the raw material to final products adapts one-way system, which can maximise the space utilisation and avoid cross-contamination. DNV notes that such layout is typical for cell manufacturing facility in the battery industry.

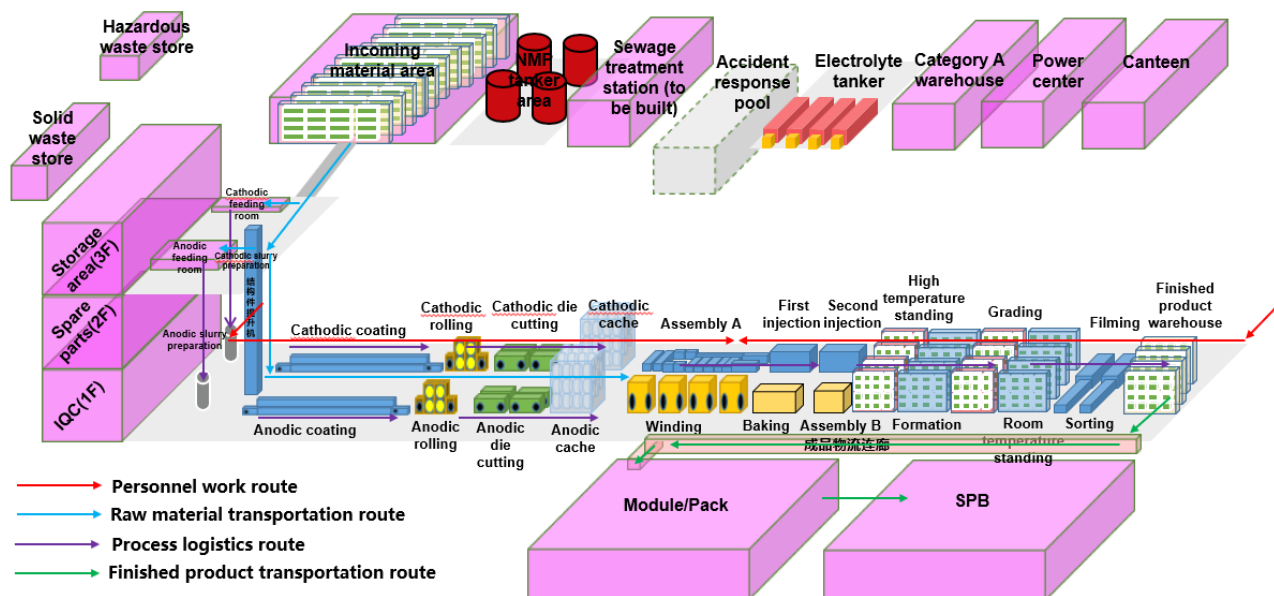


Figure 5-6 Layout of CSI's cell manufacturing facility

5.2.2 314 Ah cell manufacturing

The cell manufacturing is made up of three phases – electrode preparation, assembly, and testing. The cell production equipment used in CSI's manufacturing facility is highly automated. The production area implements stringent temperature, humidity, and dust control. Figure 5-7 shows the process flow diagram of the cell production.

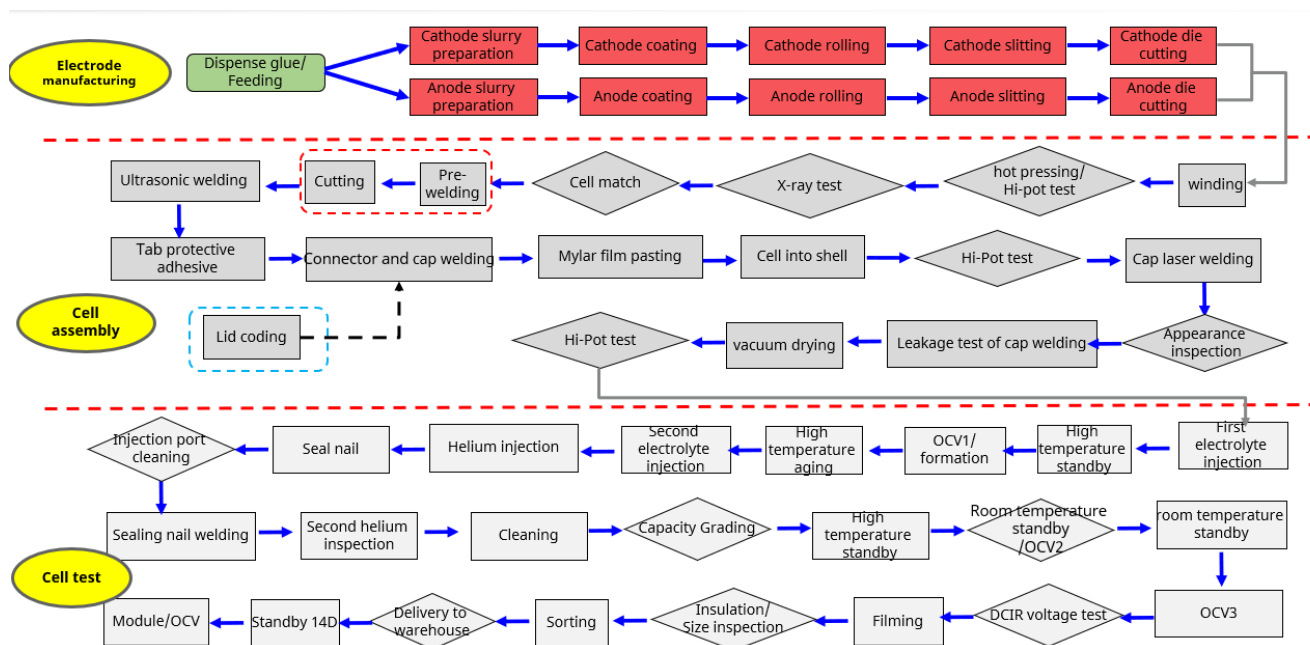


Figure 5-7 Process flow diagram of 314 Ah cell production in CSI's manufacturing facility

DNV did not inspect the full cell production process as the whole electrode manufacturing phase and part of the cell assembly phase shutdown due to the upcoming holiday. In addition, DNV was informed that the process verification and production part approval process (PPAP) are not completed. DNV suggested having another visit once these are done.

During the cell production, the quality of each production process is assured by in-line quality monitoring. If a manufacturing parameter exceeds specification, the system will detect it and identify it as non-conforming sample. As an example, Figure 5-8 illustrates the real-time cap welding quality inspection.

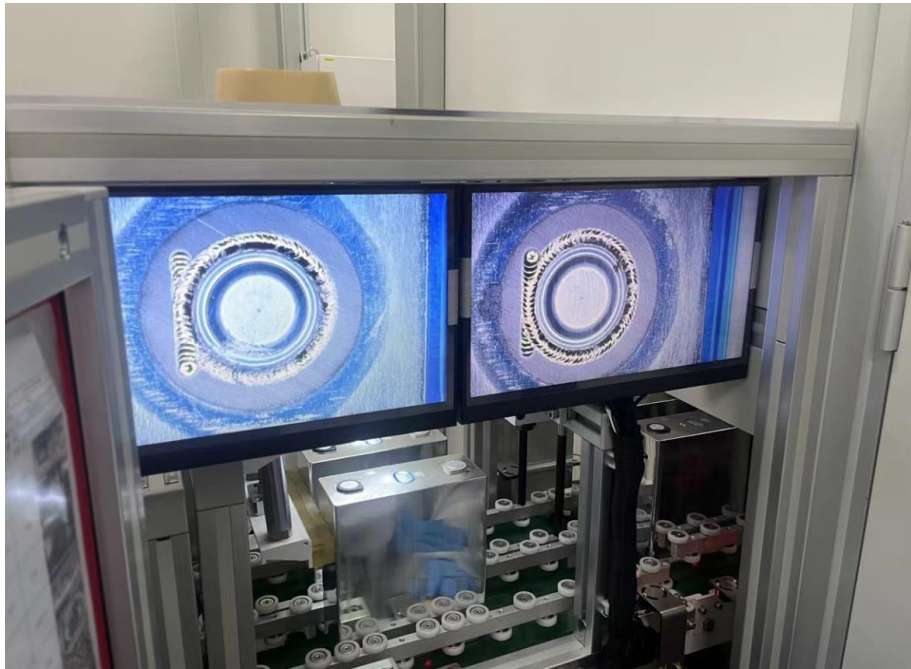


Figure 5-8 Cap welding quality inspection

Figure 5-9 show a set of photos reflecting the overview of different locations along the cell production line in CSI's manufacturing facility.



Slurry preparation



Electrode coating



In-process quality control and quality documents



Dust removal magnetic bars for slurry



Electrode calendaring



Die cutting



Electrode winding



Electrode assembly area



Cell drying



Electrode injection equipment

Figure 5-9 Highlight of CSI cell production line

Overall, DNV looks favourably on the layout and cleanliness of the production area. The equipment maintenance is executed to the clearly defined standard within the organisation. The quality inspection document, including in-process quality control, manufacturing production monitoring, non-conforming product management, and training are implemented with high standards. DNV suggests visiting CSI's cell production facility again once the process verification and PPAP processes are completed.

6 PRODUCT SUPPORT EVALUATION

CSI's 314 Ah cell is intended to be used in its SolBank 3.0 product only, therefore there is no customer service or a separate product warranty specifically for the cell product. This chapter only contains a summary of CSI's service organization, of which the content is aligned with DNV's technology review of CSI (e-STORAGE)'s SolBank 3.0 product (report No.10513636-HOU-R-01) [10].

6.1 Service organization overview

e-STORAGE makes use of an in-house monitoring/asset management software called CSEye, which provides 24x7 remote monitoring, diagnostics, and troubleshooting capabilities for 365 days of the year. Daily, monthly, and annual reports can be created which provide performance statistics for the relevant operational period being reported on, as well as summaries of preventative maintenance work deducted, use of spare parts, and any root cause analysis for corrective maintenance that may have occurred. e-STORAGE can maintain an inventory of spare parts either on or off-site per the requirements of the respective project owner.

DNV requested information pertaining to the locations of the service centers, the location of the network operation center (NOC), if present, as well as the organizational chart of the O&M services team. e-STORAGE stated that the field service team is setting up a service center in Arizona, and their current NOC is in Guleph, Ontario in Canada. DNV reviewed the organizational chart provided by e-STORAGE, and considers it to be within typical expectations for O&M service providers.

e-STORAGE provided DNV its corrective and preventive action process (CAPA). It outlines the procedures and responsibilities for identifying, investigating, correcting, and preventing nonconformities within e-STORAGE's business operations, quality management system, processes, products, and services. The purpose of this procedure is to ensure continuous improvement and enhance customer satisfaction by addressing issues systematically. In addition, 8D (Eight Disciplines) is in place for problem-solving process, which is a structured approach to identifying, correcting, and preventing issues. This template is used to document the entire process, from problem description to the implementation of corrective actions and lessons learned.

The CAPA process is applicable to all e-STORAGE regions outside China and affects all departments. It involves several key roles, including the quality department, corrective action request (CAR) initiator, CAR assignees, and management/leadership. The CAR document outlines the process for managing CARs to ensure problems are resolved and prevented from recurring. Verification of corrective actions is done through review, inspection, testing, or auditing and all evidence is uploaded to the CAR Log. The quality dashboard monitors trends and reports CAR progress.

Logs events and maintenance activities at the CALD-BESS site from August to November 2024 details scheduled and unscheduled events, including alarms and data loss incidents. It tracks issues such as inverter failures, communication losses, HVAC repairs, and high battery temperatures, ensuring all are documented, investigated, and resolved.

DNV considers it to be in line with industry expectations.

6.2 Warranty review

CSI informed DNV that the 314 Ah cells are used internally in CSI's SolBank 3.0 utility BESS only. CSI has no plan to supplier its 314 Ah cell products externally to other BESS integrators. For this reason, CSI does not provide separate product warranty for the 314 Ah cell. However, DNV acknowledges that CSI provides BESS product and performance warranty, which is reviewed to adequate details in DNV's SolBank 3.0 BESS technology review report [10].

DNV recommends updating this section when the cell level product warranty is available.

7 REFERENCES

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- [10] DNV, 10513616-HOU-R-01-E e-STORAGE SolBank 3.0 BESS Technology Review.



About DNV

DNV is a global quality assurance and risk management company. Driven by our purpose of safeguarding life, property, and the environment, we enable our customers to advance the safety and sustainability of their business. We provide classification, technical assurance, software, and independent expert advisory services to the maritime, oil & gas, power, and renewables industries. We also provide certification, supply chain and data management services to customers across a wide range of industries. Operating in more than 100 countries, our experts are dedicated to helping customers make the world safer, smarter, and greener.