



Inspire Every Battery

[Use EV with Confidence by Remanufactured battery]

POEN stands for Positive Energy. It is our mission to reuse the wasted energy and resource as they were to create new positive value as ECO oriented start-up. Our mission is not limited to Republic of Korea. To share our value for brighter and greener future of our planet and children, we are expanding our recycling resource value with remanufacture technology to Europe and United State of America. By utilizing our Battery-Up-Scaling technology, the used xEV Batteries shall be used for their own purpose once again. We are eager to cooperate with the entire Europe to build Eco-friendly auto industry environment and support our customers to drive xEV with safety and sustainability.

“We hope that even the last appearance of Green EV will stay future-friendly till the end”

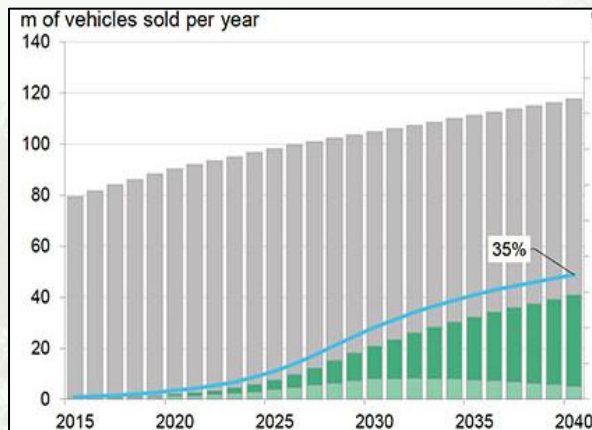
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1. Background



For electric vehicles to be genuinely eco-friendly, batteries must be completely utilized and recycled.

EV must be widely distributed!
The promising near future



- EV Sales forecast @ BNEF

Risk of Post-Use Battery :
Pollution, Fire



- Used xEV Battery Storage status @ 2017

Extremely expensive service cost :
Dissatisfaction & Reluctant to buy EV

Automotive News

One Tesla owner picks dynamite over costly repair

Faced with a \$22,600 bill to replace the battery on his Tesla Model S, a Finnish man decided to blow up the car instead.

January 10, 2022 12:00 AM

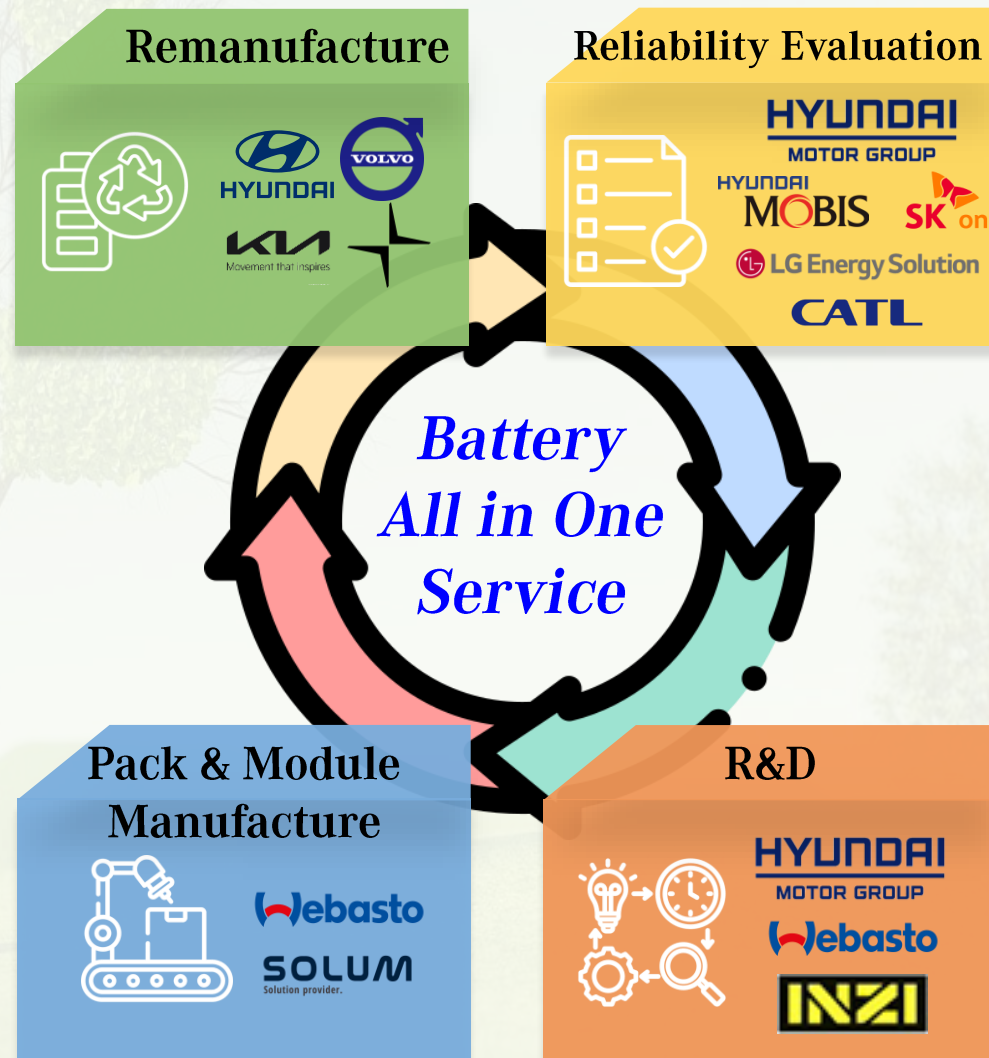


2. Company Profile



Battery Engineering Service Platform

Company Name	POEN Co., Ltd. (HQ)	POEN Europe GmbH
Establishment	November 18, 2019	April 25, 2024
CEO	Sung-Jin Choi	Sang-Uk Lee
Location	Gunpo, Gyeonggi-do Republic of Korea	Sachsenheim, Baden- Württemberg Germany
Employees	111	4
Stakeholder	Hyundai Motor Company, KIA, Hyundai Marine&Fire Insurance, LOTTE rental, Hyundai Motor Securities, Korea Development Bank and 10 VCs in Korea	
Partners	Hyundai Motor, Kia, Volvo, Polestar, Hyundai Mobis, Webasto, CATL, SK ON, POSCO, EcoPro, Sungil Hi-Tech, Samsung Fire & Marine Insurance etc.	



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2. Company Profile Global Network



POEN Co., Ltd Since 2019

Admi. and R&D Center in Gunpo | 2 Mass-Production Plants and 1 Logistic Center in Hwaseong

POEN Europe GmbH Since 2024

Workshop for R&D and Remanufacture in **Stuttgart area**

POEN America Inc. Since 2024

Workshop for Flying Doctor Service and Remanufacture in Detroit

POEN Vietnam Since 2025

Workshop for Battery Module Packing in Hanoi area

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2. Company Profile History

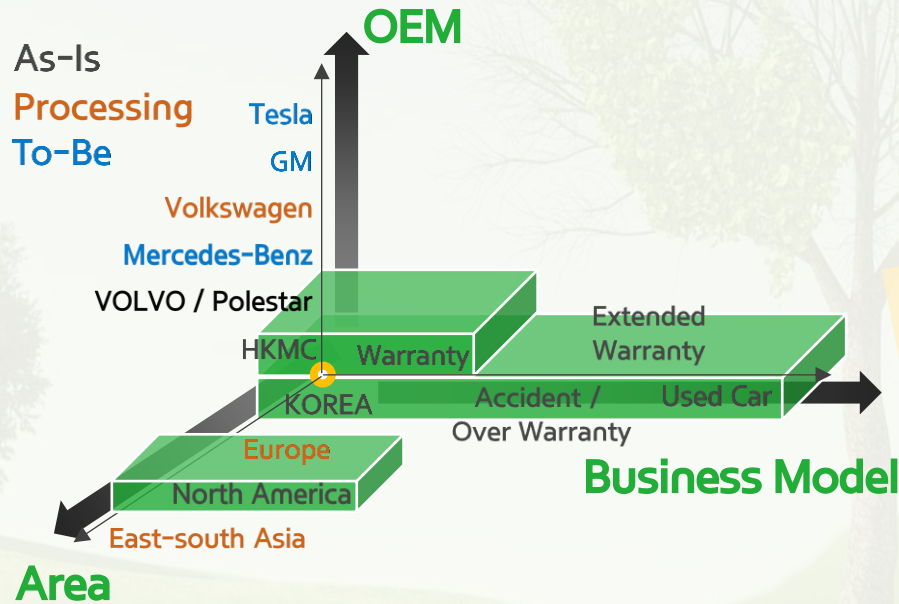


2019	11	Established POEN Co., Ltd
2020	07	Installed UPS from used PHEV batteries at KIA's plant
	10	<u>Prototype battery development contract with Webasto</u>
	11	<u>Battery remanufacturing and repair contract with Hyundai Motor Company and Kia</u>
2021	10	Designated as an energy startup by Korea Electric Power Corporation
2022	01	<u>Quality analysis contract with CATL</u>
	06	<u>Joint promotion with KIA for the NIRO Plus 「Refurbish Service」</u>
	08	Acquired equity of EVC Co., Ltd. for battery recycling pre-treatment
	12	Began operation of the mass-production plant in Hwaseong
2023	04	Developed 4 th -generation EV battery module and Produced 500 units
	11	Awarded the Minister of Trade, Industry, and Energy's Award for Manufacturing Service Integration
2024	01	<u>Won the CES 2024 Innovation Award</u>
	01	Established U.S subsidiary
	03	<u>Won the “Best Innovation Award” at InterBattery 2024</u>
	04	Established European subsidiary in Germany
	08	<u>Battery remanufacturing and repair contract with Volvo and Polestar</u>
	12	Launched BEV Flying Doctor Service in U.S.A
2025	03	Established Vietnam subsidiary

3. VISION



For EV owners **use their vehicle with confidence,**
remanufactured EV battery **must be spread to every OEM and area.**



In Germany, POEN's proven remanufactured EV battery will come soon near Stuttgart.



POEN will expand to 3 axes ① Business Area, ② Business Model, ③ OEM

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4. Business Area ① Remanufacturing



Through remanufacturing, improved electric vehicle service parts can be secured, **reducing the burden of cost, performance, and inventory.**

Cost

- Pack replacement is extremely expensive.

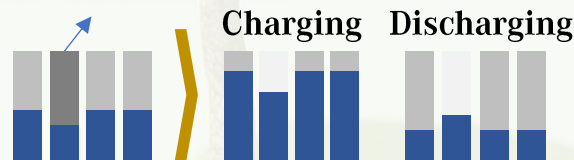


BATTERY,90KWH,5X(1101078-00-A)				
Correction: No Labor Performed - P				
Replaced				
Total Parts Amount 31,025.92				
Parts Subtotal 21,025.92				
Adjustment				
Subtotal				
0.00				
0.00				
Parts Replaced or Added				
Part	Quantity	Unit	Price	Subtotal
MSX HV BATTERY	1.00		10,000.00	10,000.00
CORE CHARGE(1234555-01-A)				
				Parts Subtotal 10,000.00

Remanufacturing is 20~30% of the price of a new own.

Performance

- Replace the degraded modules in the battery pack with new ones.
→ Causes ongoing performance variations and stress on the existing battery.



Combine modules with similar usage levels to stabilize performance and degradation.

Inventory & Chemical modification

- Batteries are heavy and bulky, requiring a large storage space.



- Since it is a chemical-based product, prolonged storage without use can lead to performance degradation.

By combining used batteries, inventory burden is reduced in terms of space and time.

4. Business Area ① Remanufacturing



Through **integrating fundamental technologies with reliable quality**, remanufactured EV battery could be commercialized.

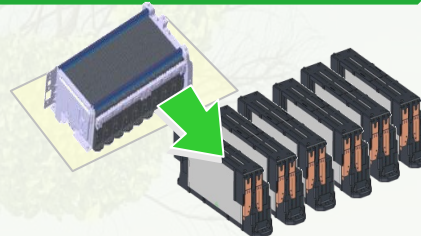
Incoming



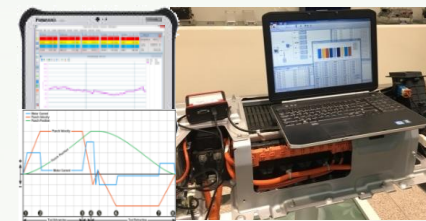
Failure Cause Analysis



Assemble & Disassemble



Final Inspection

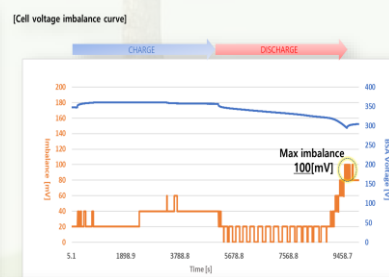


Time	Chn	ID	Name	Event Type	Dir	DLC	Data
245.043	CAN	1505		CAN Frame Tx	8	00 00 00 00 00 00 00 00	
245.918	CAN	1585		CAN Frame Tx	8	00 00 96 C0 F4 01 C0 0C	
353.837	CAN	1584		CAN Frame Tx	8	00 00 00 00 82 82 00 00	
353.801	CAN	1586		CAN Frame Tx	8	00 00 00 00 00 00 00 00	
353.894	CAN	1291		CAN Frame Rx	8	00 00 00 00 00 00 00 00	
353.894	CAN	1523		CAN Frame Rx	8	08 00 00 00 00 00 00 00	
353.895	CAN	1524		CAN Frame Rx	8	00 00 00 00 00 00 00 00	
353.896	CAN	1200		CAN Frame Rx	8	00 00 00 00 00 10 00 00	
353.793	CAN	17E4		CAN Frame Rx	8	02 10 03 00 00 00 00 00	

BMS communication



Communication interface



Quality evaluation method

Remanufacturing Evaluation System			
Main information		Voltage	
SOC	SC4	0.780 V	0.780 V
SOI	100%	0.780 V	0.780 V
Pack V	Current	0.780 V	0.780 V
370 V	0.0 A	0.780 V	0.780 V
Max Cell	Min Cell	0.780 V	0.780 V
3.780 V	3.780 V	0.780 V	0.780 V
Max Temp	Min Temp	0.780 V	0.780 V
23°C	22°C	0.780 V	0.780 V
COG	COG	0.780 V	0.780 V
0.0 Ah	0.0 Ah	0.780 V	0.780 V
Insulation	OC	0.780 V	0.780 V
0.020 V	0	0.780 V	0.780 V
COE	0	0.780 V	0.780 V

Diagnosis S/W

85-물류			
입고	세척	기초검사	분해조립
1114 (9)	1077 (6)	1064 (1)	974 (0)
성능검사	EOL	출하검사	출하
957 (4)	929 (0)	825 (1)	819 (0)

Data management

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4. Business Area ① Remanufacturing



<https://www.youtube.com/watch?v=pO-GY-gHDqE>

4. Business Area ① Remanufacturing



Who repair damaged or defective battery and
Potential EV consumers need remanufactured EV battery.

Reasonable Price & Proven Quality

Remanufactured Battery

Analysis of the
cause of failure

Repair /
Replacement

Battery
Evaluation

Final
Inspection



EV OEM



Insurance company



Finance / Used car Dealer / Mobility Operators



OEM Warranty repair

Out of Warranty repair

Extended Warranty

EV Battery Subscription
(Lease/Rent)

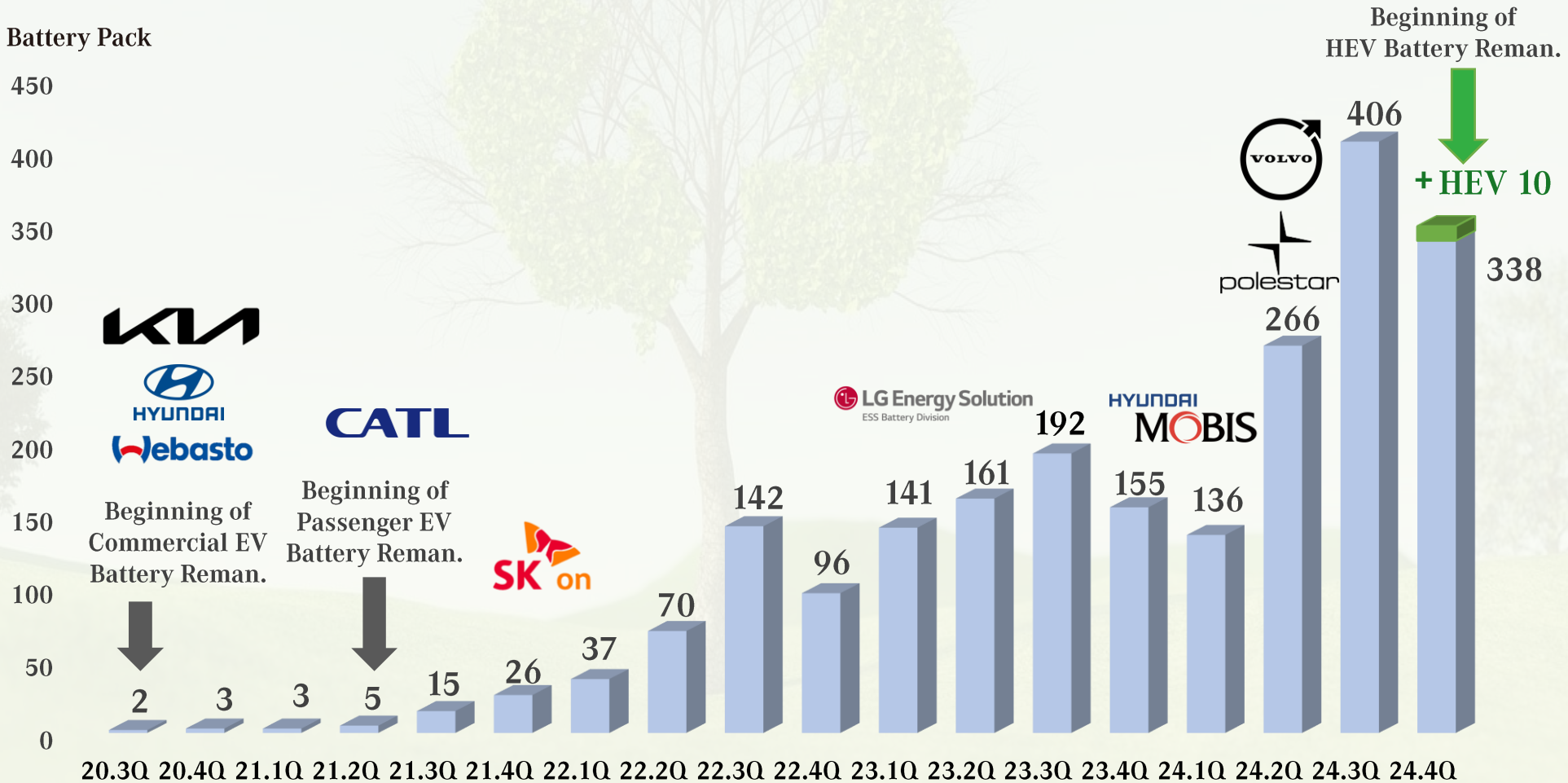
Used EV Battery Warranty
/ Assurance

4. Business Area ① Remanufacturing



**POEN has strong partnerships
with major corporates in a promising market.**

Unit : Battery Pack



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- By analyzing defective parts obtained while the remanufacturing process, POEN provides essential information for improving client quality standards.

Defective Parts Information

[illegible]

■ BSA 용량평가 데이터 ('21.8 ~ '22.4)					
차종	품번	R/O No.	주행거리 (단위:Km)	Capacity (단위 : Ah)	
DE_EV	37501-Q4151	FK0110-2020-W-004363	5,151	179.57	
DE_EV	37501-Q4050	209000-2020-W-031042	37,150	182.08	
DE_EV	37501-Q4050	205000-2020-W-021375	26,627	181.98	
DE_EV	37501-Q4050	203000-2020-W-005637	40,864	182.30	
DE_EV	37501-Q4050	FK0110-2020-W-004887	69,862	175.27	
LK_EV	37100-8KEA2	A1M001-2020-2-002499	1,365	181.84	
CS_EV	37100-5D250	N1Z005-2021-2-000113	43,247	175.04	
CS_EV	37100-5D200	N1Z005-2021-2-000113	43,247	173.61	
CS_EV	37100-5D250	030620BS70004C1	31,084	175.76	
CS_EV	37100-5D200		31,084	172.21	
CS_EV	37100-5D200		31,084	178.82	
CS_EV	37100-5D250		6,470	176.06	
DE_EV	37501-Q4000	209000-2020-W-025304	83,784	177.32	
LK_FCEV	37100-8KEA1		808	121.32	
LK_EV	37100-8KEA1		312	175.20	
HR_EV	37501-CN000	P02000-2020-2-018244	1,348	183.73	
HR_EV	37501-CN050	M01000-2020-2-018571	7,191	180.42	
LK_EV	37100-8KEA1	H10D02-2021-2-000414	40,764	170.83	
LK_FCEV	37100-8KEF1	A1Z006-2021-2-000663	21,136	118.99	
OS_EV	37501-K4050	B08000-2021-2-004979	75,262	178.99	
CS_EV	37100-5D250	J01K01-2021-2-001014	28,598	173.49	
PU_EV	37501-CN050	205000-2020-W-030515	4,978	183.02	
DE_EV	37501-Q4050	212000-2021-W-012984	78,243	178.41	
DE_EV	37501-Q4050	212000-2021-W-012984	51,167	179.32	
CS_EV	37100-5D100	H10D02-2021-2-000882	63,472	171.21	
CS_EV	37100-5D200	H10D02-2021-2-000882	63,472	174.61	
CS_EV	37100-5D250	H10D02-2021-2-000882	63,472	171.21	
SK3_EV	37051-Q4050	217000-2020-W-002568	79,519	181.16	



4. Business Area ② Reliability Evaluation



Scope of performance

Category	Items	Pack	Module	Cell	Category	Items	Pack	Module	Cell
Assembly Strength	Torque Test	●	-	-	Environmental Tests	Temperature Characteristics	●	●	TBD
Battery System Functions	W/H Short Circuit Test	●	-	-		Temperature Cycle	●	●	TBD
	CAN Communication Test	●	-	-		Temperature & Humidity Cycle	●	●	TBD
	High Voltage Relay Control	●	-	-		High Temp & High Humidity Power Applied	●	●	●
Basic Performance Tests	Capacity Test	●	●	●		Low Temp Operationn/Storage	●	●	●
	Constant Power Test	●	●	●		High Temp Operation/Storage	●	●	●
	DCIR Test	●	●	●		Thermal Shock	●	●	●
Battery Pack Performance	Insulation Resistance	●	-	-		Vibration	TBD	TBD	TBD
	Operating Voltage, Power Consumption, Dark Current	TBD	-	-		Shock	TBD	TBD	TBD
	Overvoltage, Reverse Voltage, Power Voltage Fluctuation	TBD	-	-		Waterproof	TBD	-	-
	Power interruption, Power Voltage Drop	TBD	-	-		Coolant Channel Leak/Burst	●	-	-
	Voltage Fluctuation During Start	TBD	-	-		Water Spray Test	TBD	TBD	TBD
	Short Circuit	TBD	-	-		Altitude Test	TBD	TBD	TBD
	Battery Charge/Discharge (12V)	TBD	-	-		Corrosion	TBD	TBD	TBD
	Surge Voltage Test (EMC)	TBD	-	-		Case Presuure Test	TBD	TBD	TBD
	Radiated &Conducted Immunity(EMC)	TBD	-	-	Safety Tests	Penetration	TBD	TBD	TBD
	Conducted Emission, ESD (EMC)	TBD	-	-		Compression (X, Y, Z)	TBD	TBD	TBD
	Cooling Performance 1,2	●	-	-		Impact - Front, Rear, Side	TBD	TBD	TBD
	Max Battery Charge / Discahrge Power	TBD	-	-		Submersion	TBD	TBD	-
	Relay On/Off Operation Sound	●	-	-		Drop Test	TBD	TBD	TBD
	AC Dielectric Strength Test	TBD	-	-		Thermal Exposure	TBD	TBD	TBD
Reliability Tests	Charge/Discharge Cycle Life	●	●	●		Combustion	TBD	TBD	TBD
	High Temp Storage, Low Temp Storage	●	●	●		Short-Circuit (Room Temp)	TBD	TBD	-
	Temperature & Humidity Storage	●	●	●		Short Circuit (High Temp)	TBD	TBD	-
	Temperature & Humidity Cycle	●	●	●		Overcharge (Slow/Fast)	●	●	●
	Thermal Shock	●	●	●		Forced Discharge, Over-discharge	TBD	TBD	TBD
	Condensation Characteristics	●	●	●		Thermal Propagation	TBD	TBD	-
	Dust Characteristics	TBD	TBD	TBD		Bottom Impact 1 (2m)	TBD	-	-
	Salt Spray	TBD	TBD	TBD		Bottom Impact2 (5m)	TBD	-	-

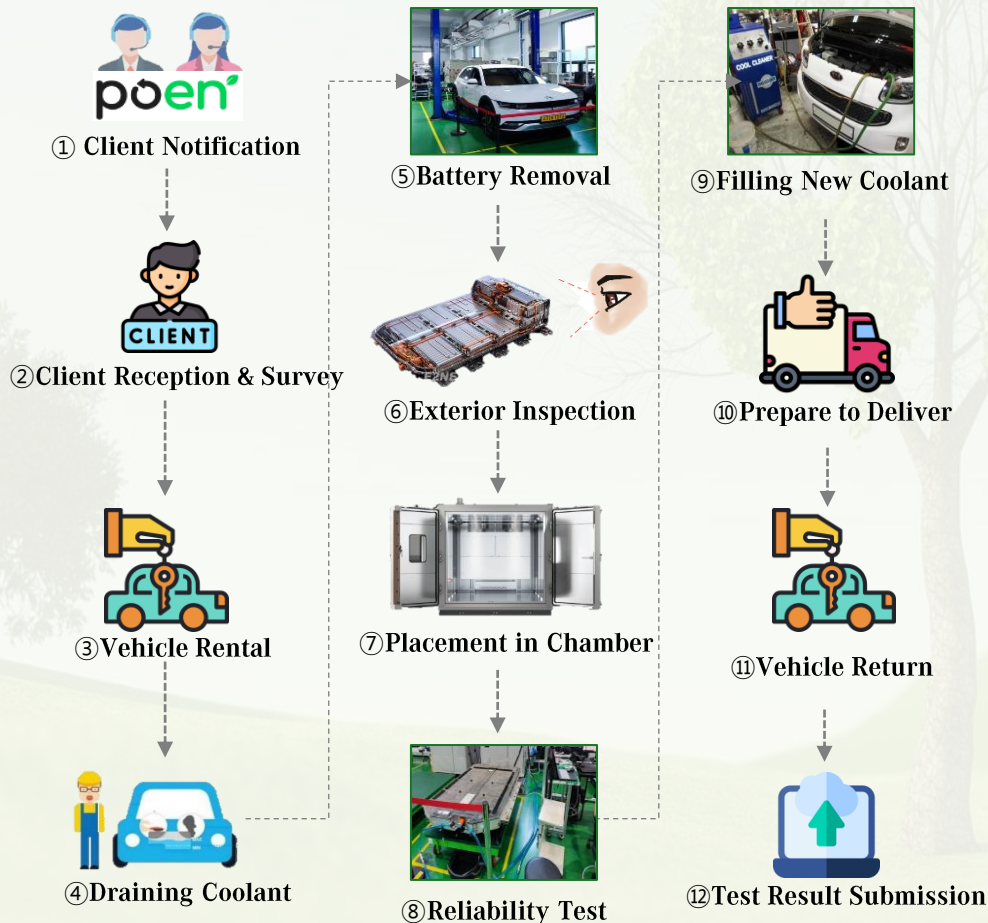
4. Business Area ② Reliability Evaluation



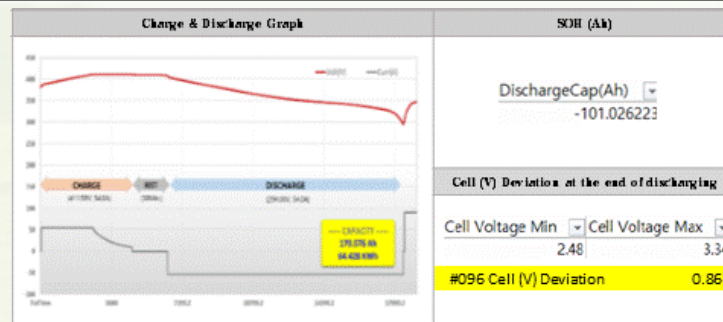
In-use EV battery evaluation project



- Reliability and performance test for In-Use Batteries
- Handling about 10 EV in every week from 2023



Vehicle Photo				Battery Pack Photo					
Stocked in Photo		Shipment Photo		After Detachment		Before Assembly			
Stocked in time : Mar.20.2024_17:30		Shipment time : Mar.21.2024_17:34		Detachment time : Mar.20.2024_18:00		Assembly time Mar.21.2024_16:57			
No.	Inspection List	Procedure	Standard	Inspection Result				Remark	
1	Initial Inspection	Vehicle	Exterior, Engine Start, DTC Code check (Visual & CDS Diagnosis)	* Exterior/Engine Start : Not damaged or Defective * DTC Code : Doesn't Exist	Exterior	Engine Start	DTC Code		-
		Battery Pack	Pack Exterior, Communication Status Check (Visual & CDS Diagnosis)	* Exterior/Communication : Not damaged or Defective * Insulation Resistance : 3000Ω * Voltage Deviation : below 40mV	OK	OK	None		
					OK	Comm.	Insulation Resistance	Voltage Deviation	
2	SOH Test	First	Charging Cap. : 1/3C, 0% > 100% Discharging Cap. : 1/3C 100% > 0%	* SOH over 90% - ION103/ENV : 100,000Ah - N1RO Plus : 162,000Ah * Cell Deviation after Discharging : below 80mV	Discharging Cap.		Cell (V) Deviation after Discharging		Max. Cell Voltage : 4.06V Min. Cell Voltage : 4.05V Max. Cell Voltage : 3.34V Min Cell Voltage : 2.89V Trucking Maintenance Required
					10.1036		660		
		Second	Charging Cap. : 1/3C, 0% > 100% Discharging Cap. : 1/3C 100% > 0%	* SOH over 80% - ION103/ENV : 89,760Ah - N1RO Plus : 144,000 Ah * Cell Deviation after Discharging : below 80mV	Discharging Cap.		Cell (V) Deviation after Discharging		
3	DCIR Test	SOH80%, 0.5C-10s Charging/Discharging, LOC-10s Charging/Discharging, 60s pause between steps	-	LOC Charging	LOC Discharging	LOC Charging	LOC Discharging	Measurement Unit : (V) For Detecting Patterns	
4	EIS Test	SOH80%, Mass manufactured BMS ROM version	-	First	Second	Third	-	Measurement Unit : (V) For Detecting Patterns	
5	Shipment Test	Battery Pack	Pack Exterior, Communication Status (Visual & CDS Diagnosis)	* Exterior/Communication : Not damaged or Defective * Insulation Resistance : 3000Ω * Voltage Deviation : below 40mV	Exterior	Communication	Insulation Resistance	Voltage Deviation	Max. Cell Voltage : 4.00V Min. Cell Voltage : 4.00 V
					OK	OK	3000	0	
		Vehicle	Exterior, Engine Start, DTC Code check (Visual & CDS Diagnosis)	* Exterior/Engine Start : Not damaged or Defective * DTC Code : Doesn't Exist	Exterior	Engine Start	DTC Code		
				OK	OK	None		-	

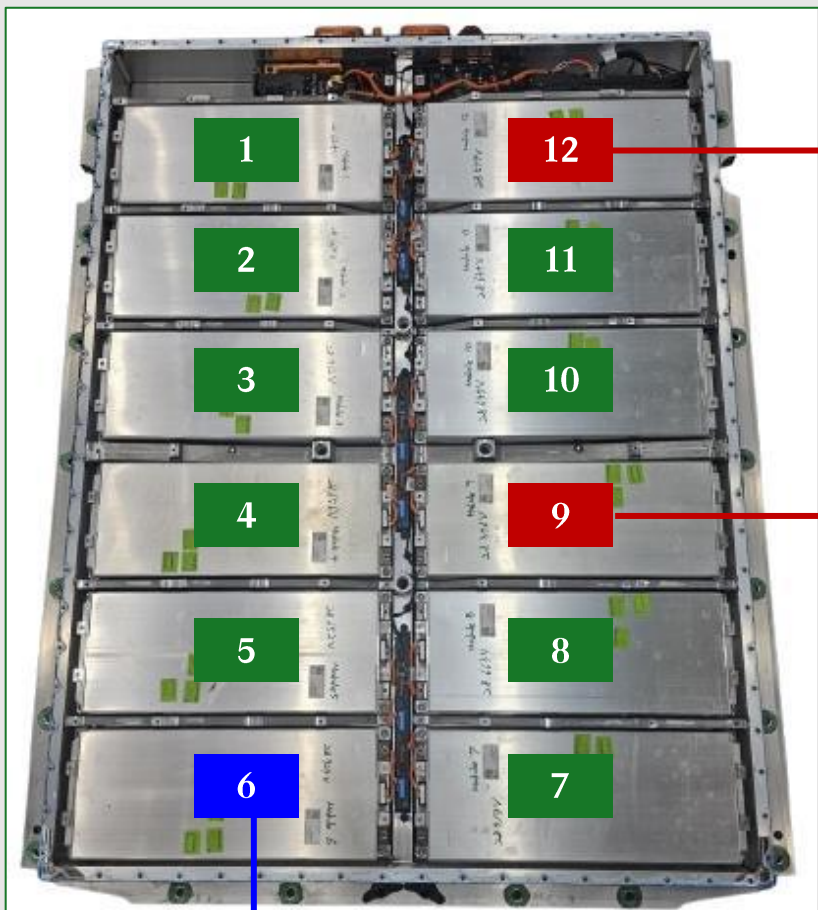


4. Business Area ② Reliability Evaluation



Teardown and analysis project

• Analysis Report Sample #1



No.	Voltage	Remarks	Pack (V)	Insulation Res.
Module 1	28.624		343.64	(+)521.0 (-)112.0
Module 2	28.663			
Module 3	28.712			
Module 4	28.656			
Module 5	28.652			
Module 6	28.727	Max Voltage		
Module 7	28.719			
Module 8	28.663			
Module 9	28.376	Min Voltage #1		
Module 10	28.637			
Module 11	28.634			
Module 12	28.579	Min Voltage #2		
AVG	28.636			
MAX	28.727			
MIN	28.376			
Difference	351mV			

4. Business Area ② Reliability Evaluation

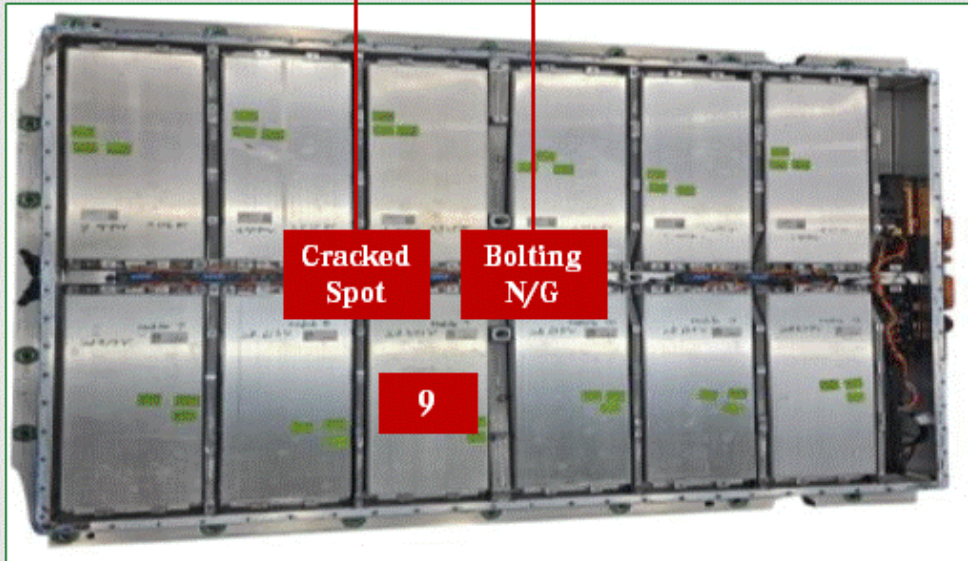
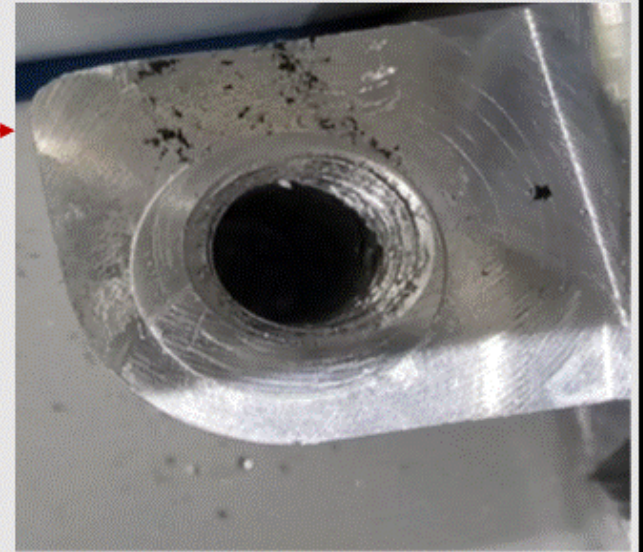


Teardown and analysis project

• Analysis Report Sample #2



Crack Wideness : x.xxmm
Crack Height : x.xxmm

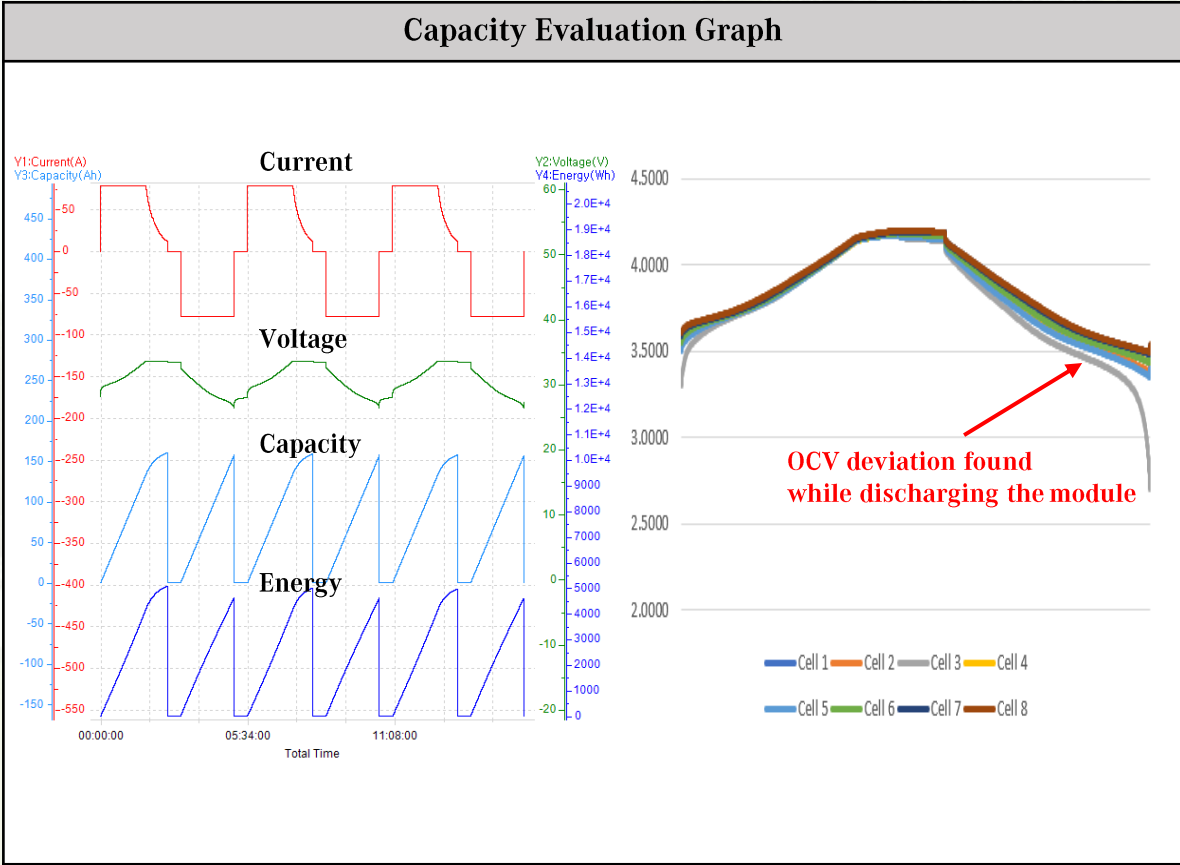


4. Business Area ② Reliability Evaluation



Teardown and analysis project

- Analysis Report Sample #3
- Low Voltage Module Capacity Evaluation (Module #9)

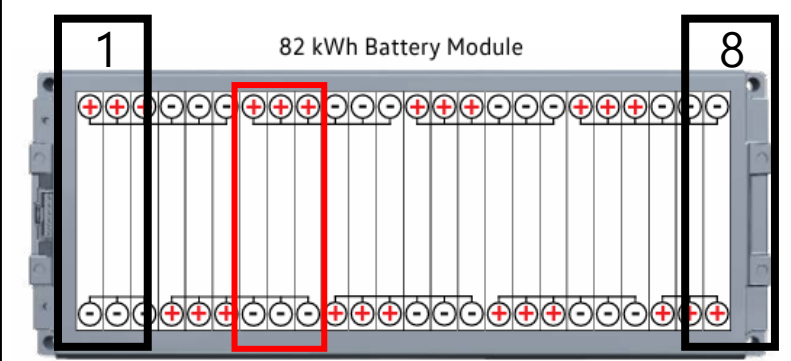


Module #9					
Cap.(Ah)	Cycle 1		Cycle 2		Cycle 3
	158.4		157.7		157.1
SOH(%)	67.7		67.4		67.1
Cell Voltage Deviation (mV)					
Complete Charge			Complete Discharge		
Cycle 1	Cycle 2	Cycle 3	Cycle 1	Cycle 2	Cycle 3
25	26.3	25.5	790.8	791.2	793.1
Cutt off Cell No.	No. 3				

1

82 kWh Battery Module

8

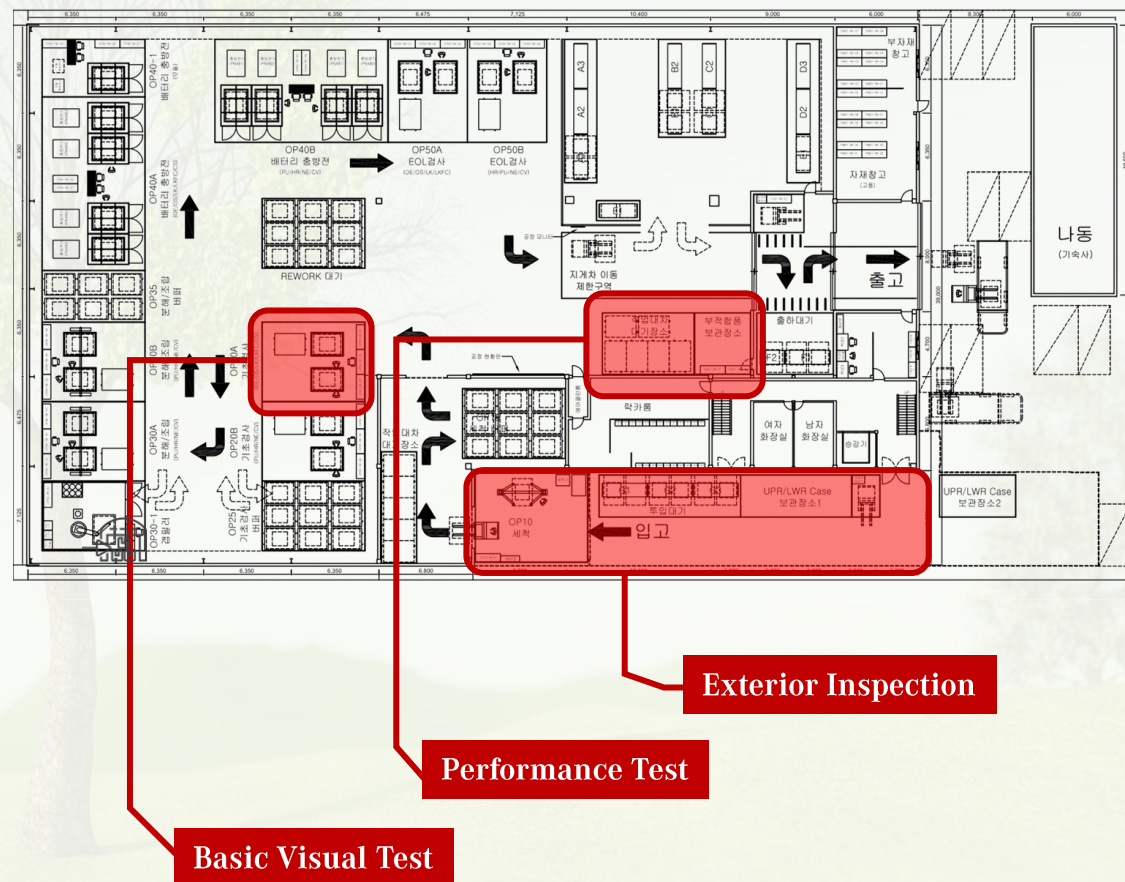
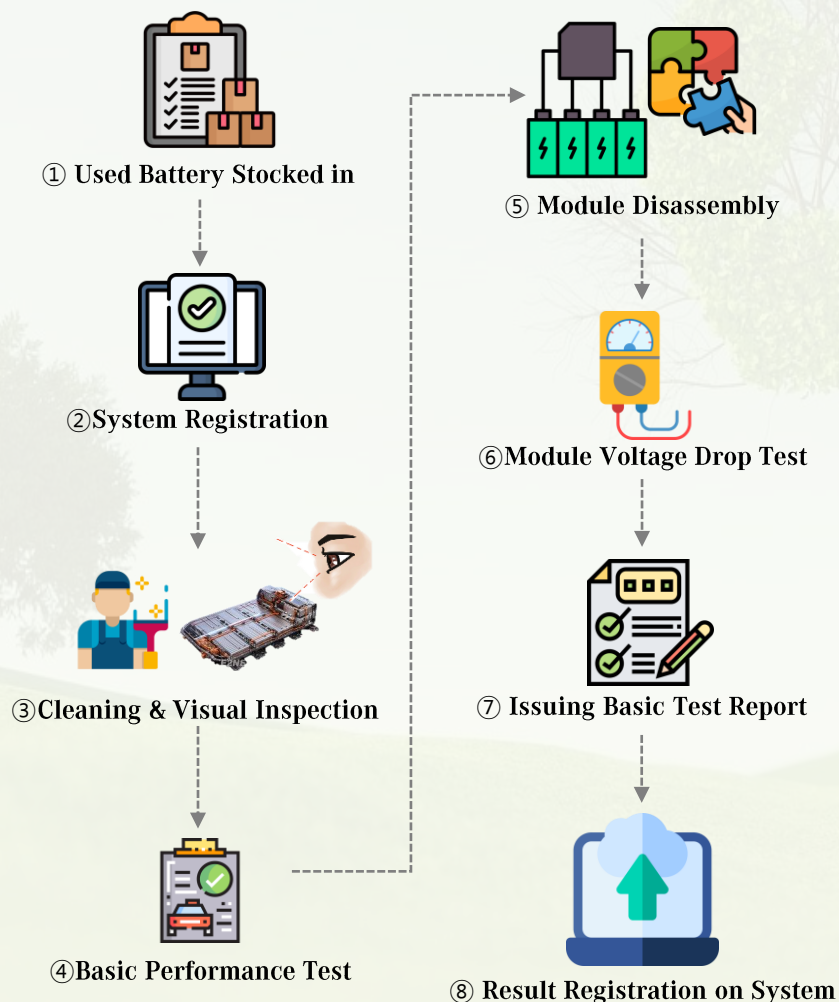


4. Business Area ② Reliability Evaluation



Breakdown battery evaluation project ^{HYUNDAI} MOBIS

- Analyzing the cause of a failed battery and deriving improvements.
- Handling about 200 battery modules and packs in every month from 2024

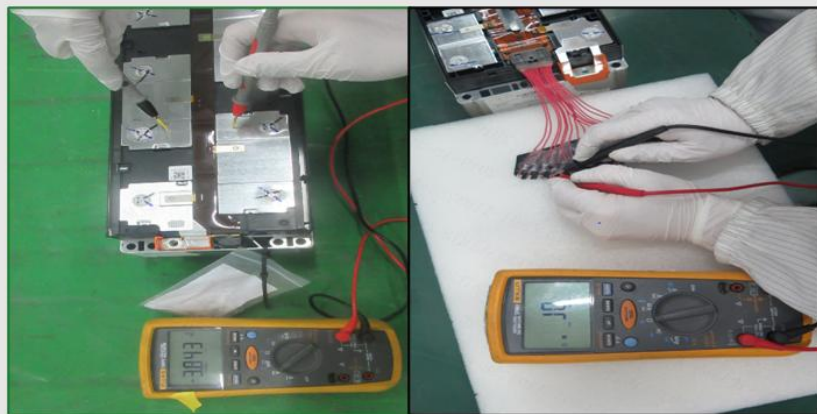
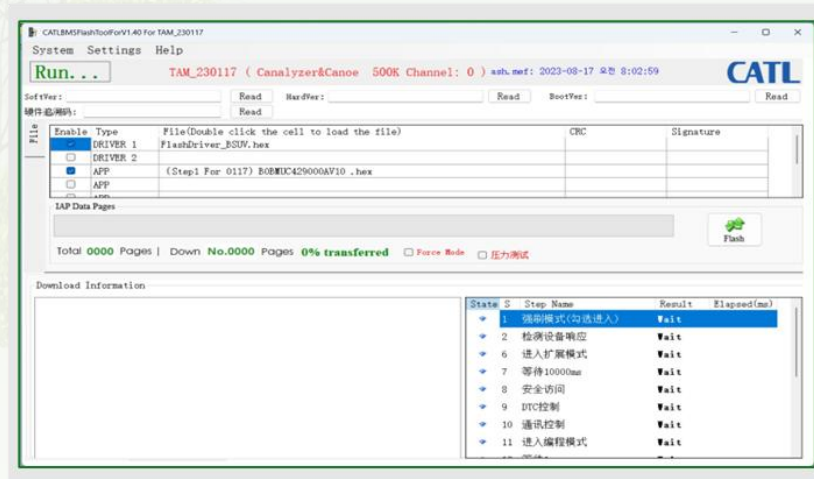
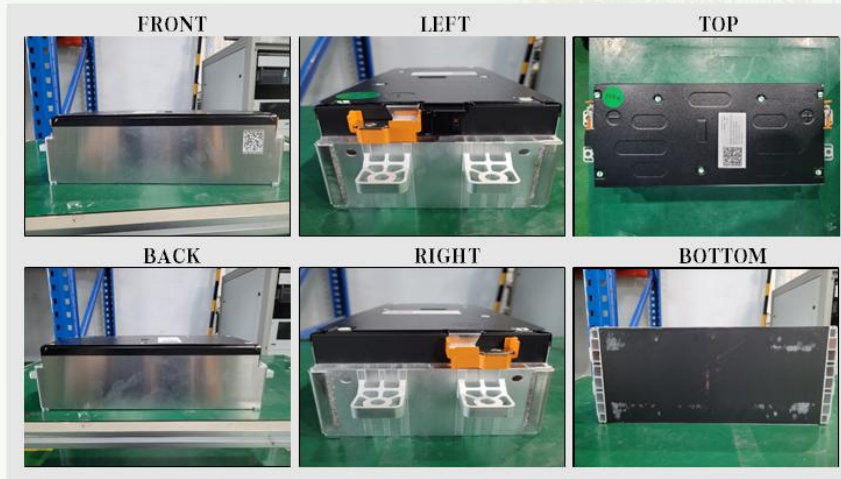


4. Business Area ② Reliability Evaluation



Breakdown battery evaluation project CATL

- Analyzing the cause of a failed battery and deriving improvements.
- Rework for software improvements
- Handling cells, modules, packs and FPCB from 2022



4. Business Area ② Reliability Evaluation

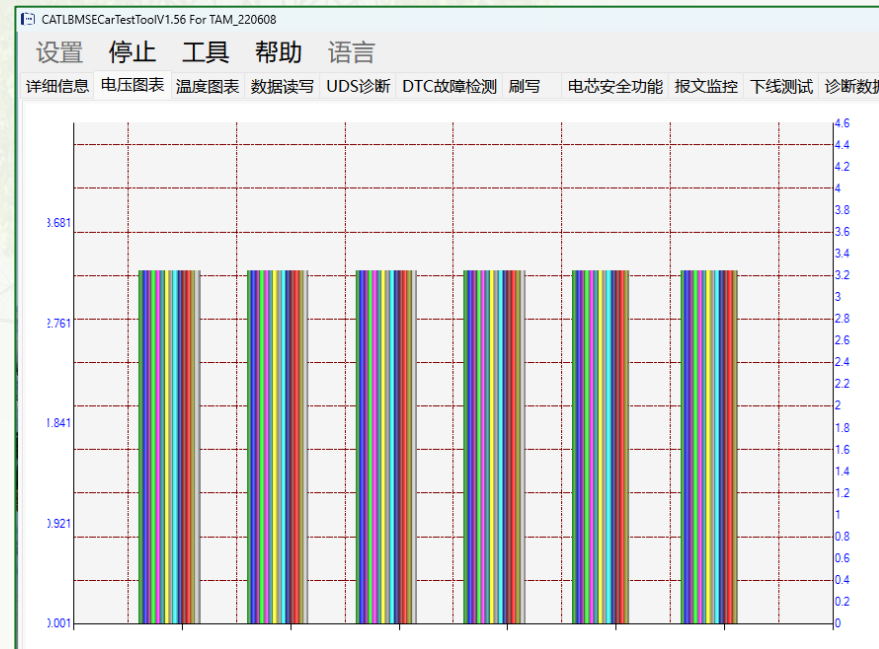


Breakdown battery evaluation project CATL

• Report Sample1

Charging Condition :

- 1) x.xC CC @Cell 3.xxV (30% SOC)
- 2) Rest xx min
- 3) x.xx C CC/CV 3.xx V
- 4) Rest x hour
- 5) EOL check (Cell Voltage check)



BatUin:	V
BatUOut:	V
Current:	A
ChgHvPos:	V
S O C:	%
S O H:	%
BatSumU:	V
RSoc:	%
CellUmax:	V
CellUmin:	V
CellUavg:	V
DeltaU :	V
Tmax:	°C
Tmin:	°C
Tavg:	°C
DeltaT :	°C
ISORPos :	kΩ
ISORNeg :	kΩ
DcEngery:	3 kwh
RegEngery:	3 kwh
VoltNum:	
TempNum:	
BMU Life:	
BMS_Fail_Level:	39

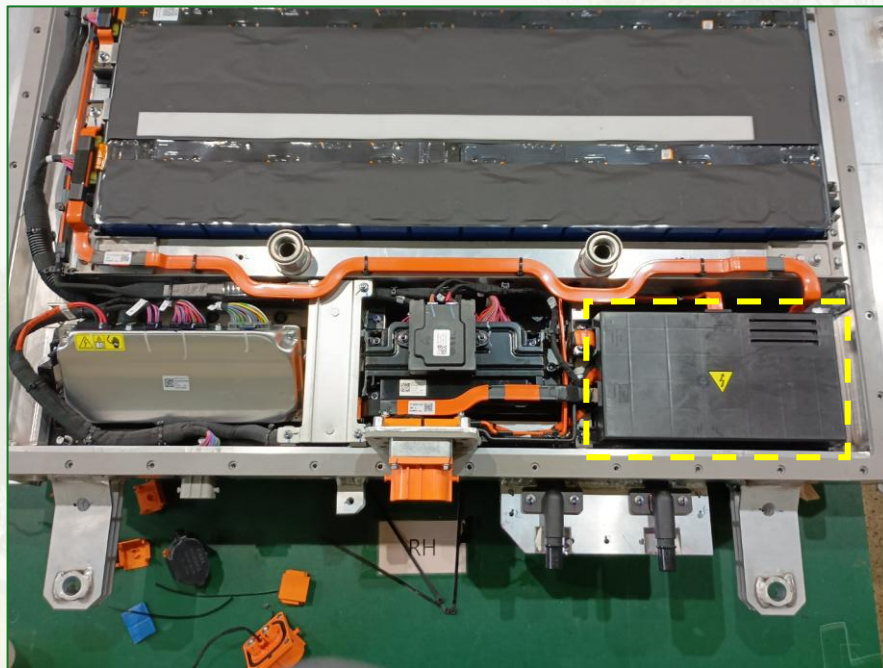
4. Business Area ② Reliability Evaluation



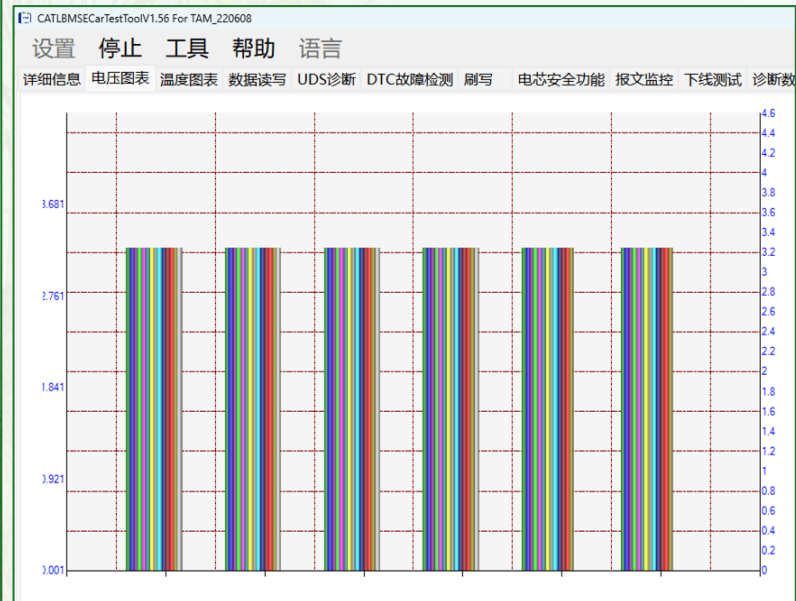
Breakdown battery evaluation project CATL

• Report Sample2

- Relay welding symptom had been found, Proceeded End-of-Line inspection after replacing Relay



EOL Result after PRA replacement:



BatUin:	V
BatUOut:	V
Current:	A
ChgHvPos:	V
S O C:	%
S O H:	%
BatSumU:	V
RSoc:	%
CellUmax:	V
CellUmin:	V
CellUavg:	V
DeltaU :	V
Tmax:	°C
Tmin:	°C
Tavg:	°C
DeltaT :	°C
ISORPos :	kΩ
ISORNeg :	kΩ
DcEngery:	kwh
RegEngery:	kwh
VoltNum:	
TempNum:	
BMU Life:	
BMS_Fail_Level	

➤ Note : After PRA replacement, The battery pack worked well.

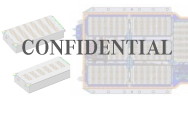
4. Business Area ③ R&D



Proto-type Battery pack and module development / Production / Test

- 1st ~ 4th generation battery design.
- Expertise in developing prototypes & T-Cars, including battery module and battery packs
- Development of solutions for mass product EOL inspection.

Major Battery Pack Development History

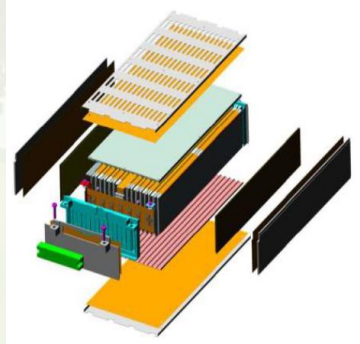
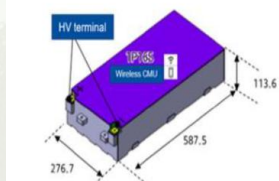
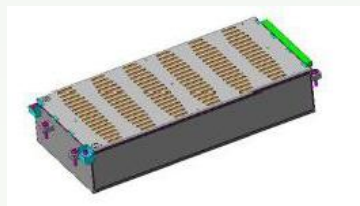
Client	Project	Notes	Remarks
	• Type : Proto-type Battery Packs • Time : Nov. 2020 ~ Feb. 2021 • Quantity : 177 units (115 long-range / 62 standard)	• Different module manufacturers for long-range and Standard models	 CONFIDENTIAL
	• Type : Proto-type Battery Packs • Time : Dec. 2021 ~ Apr. 2022 • Quantity : 93 units (59 long-range / 34 standard)	• Same module manufacturers for long-range and Standard models	 CONFIDENTIAL
	• Type : T-Car Battery Packs • Time : Jul. 2022 ~ Sep. 2022 • Quantity : 52 units (39 long-range / 13 standard)	• Module mounting structure	 CONFIDENTIAL
	• Type : T-Car Battery Packs • Time : Jan. 2023 ~ May. 2023 • Quantity : 75 units (39 long-range / 36 standard)	• Wireless communication between CMU and BMU • NCM for long-range, LFP for standard model	 CONFIDENTIAL

4. Business Area ③ R&D



Process engineering for client's mass production line design

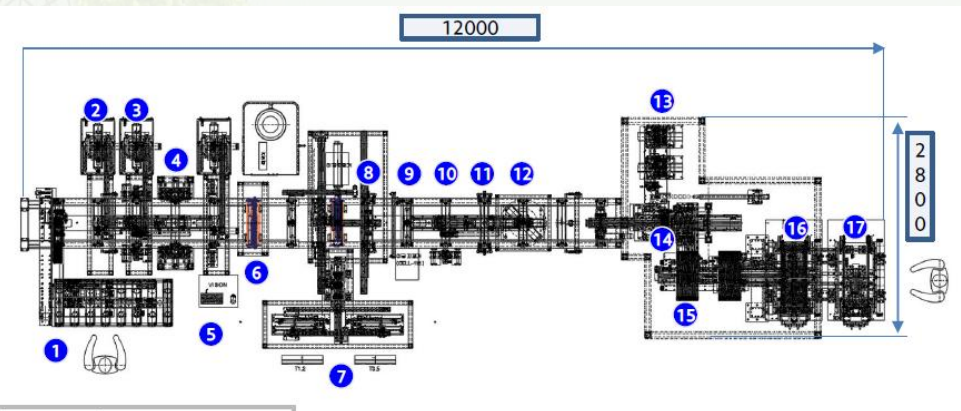
• Product Design



• Supply Chain Development

NO	CBA	PARTS INFORMATION			
		Part Name	Part Number	Image	Supplier
1	CBA	NCM Cell	SG12502		
2	CBA	LFP Cell	SG12299		
3	CBA	Heat Shield Pad , NCM	T41-66-3		
4	CBA	Heat Shield Pad , LFP	T35		
5	CBA	Spacer cpl.	SG12403		
6	CBA	Extrusion profile plus	SG12476		
7	CBA	Extrusion profile minus	SG12477		
8	CBA	Tension plate upper 16S cpl.	SG12474		
9	CBA	Tension plate upper 8S cpl.	SG12484		
10	CBA	Tension plate lower cpl.	SG12482		
11	CBA	Slot grate front cpl.	SG12478		
12	CBA	Slot grate rear	SG12480		
13	CBA	Cell-Tab-Busbar	SG12879		
14	CBA	Cell Connector	SG12814		
15	CBA	FPC (FPCB)	SG12585		
16	CBA	Warning arrester in front	SG12575		
17	CBA	Warning arrester in rear	SG12577		
18	CBA	Endplate Front	SG12479		
19	CBA	Endplate Rear	SG12481		
20	CBA	HV Plug	SG12617		
21	CBA	Screw M6x2.5 (S05458)	SG10085		
22	CBA	PI-SCREW K80x5.2 (UOF) DELTA PI VMS451	SG12638		
23	CBA	ECU_CMB_LWRMS	SG12571		
24	CBA	HOUSING CMB	SG12572		
25	CBA	DELTA PI-SCREW K30x8.0 (UOF) MIN 943 (MFL No. 422101280)	SG12682		
26	CBA	PU Foam (EV PROTECT 4000 A SFR)	11719		
27	CBA	PU Foam Hardener (EV PROTECT 4000 B SFR)	11721		
28	CBA	Gapfiller (EV T1802M XP 44261-002)	23390		
29	CBA	Gapfiller Hardener (T11 650 - KompB)	6973		
30	CBA	NH1 PAD			

• Design of production line, cost estimation for facilities, and installation supervision.



Production Facilities : \$ 14.2M

1 Cell Loading - Lifter, Conveyor, Single Axis Robot	0.80	10 Heat Shield Inspection - Location/Status check	1.60
2 Cell BCR - NG Buffer	0.30	11 Cell UP/DOWN Reverser	0.45
3 OCV Inspection - NG Buffer	0.45	12 Cell Polar Generator	0.55
4 Cell Tap cutting - Mold, Single Axis Robot	0.45	13 Side Extrusion Supply - Single Axis Robot, Conveyor	0.55
5 Cell Lead Inspection - Smart Vision, NG Buffer	1.80	14 Cell Stacking - Single Axis Robot, Servo	0.60
6 Cell Cleansing (Plasma, Blower TBD)	1.55	15 Jig Transporting Conveyor	0.50
7 Heat Shield Supply & Cleansing - (Plasma, Blower)	1.60	16 Cell Press	0.80
8 Attach Heat Shield, Remove Paper- Front/Back & Up/Down Reverser	0.45	17 Tension Plate Assembly	1.20
9 Attach Heat Shield, Remove Paper	0.55		

4. Business Area ④ Manufacturing



- Provides high-performance battery solutions for various applications
- Battery cell sourcing, Development and Manufacturing meet to clients needs

Product example

SLI | Motorcycle, Commercial



Motive | E-Scooter, Forklift



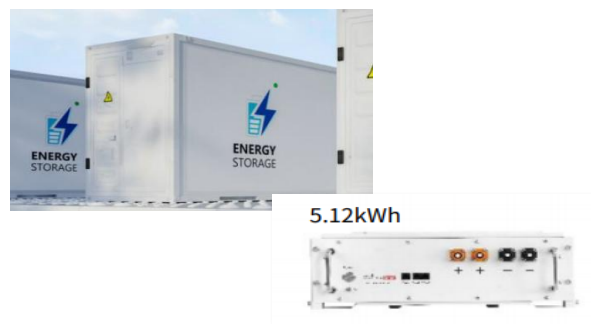
Telecom | Overseas & Domestic



UPS | Small (ES Type)



ESS | Home ESS, Large ESS



Other | Medical



5. Facility & Equipment



From 2,100m² factory near Stuttgart area at beginning stage, POEN Europe will expand capacity.

- Layout



- Overview

Address	Breuninger Str. 10, 74343 Sachsenheim
Year of Construction	2015
Total Building Area	2,122m ²
Production Area	1,231m ² (Height 6m) + 460m ² (Height 3m)=1,691m ²
Power	1,000 kVA
Fire Prevention	Automatic Fire Alarm System
Location	- Industrial complex / Automotive industry cluster : 5 min. drive from Porsche Werk plant - Bietigheim-Bissingen Station – 30 min. by bus
Highway (to Eschborn)	By car 14min, 11.3km (203km)
Main Station	By car : 40 min. / by Public Transportation : 67 min.
Airport	By car : 42min. / by Public Transportation : 96 min.
Remark	- Designated as "GI" - German Industrial Zoning : Previously used by a Porsche battery pack partner
Facility	Equipment Setup : Pack Cycler, 4 channels (1,000V) Module Cycler, 8 channels (100V) Environmental chambers → Additional cyclers planned based on volume growth Storage Capacity (based on EV pack) : Incoming: 180 units / Outgoing: 200 units

Inspire Every Battery **poen**

5. Facility & Equipment



Pack Cycler



- Battery Pack Cycler (Nebular) 2EA

- Specifications

- Max Power | 400Kw
- Voltage | 1000V
- Current Range | $\pm 50\text{mA} \sim 200\text{A}$
- Communication | CAN/CAN FD
- Channels | 2CH each

Module Cycler



- Battery Module Cycler (Nebular) 2EA

- Specifications

- Max Power | 80Kw
- Voltage | 100V
- Current Range | $\pm 50\text{mA} \sim 200\text{A}$
- Communication | CAN/CAN FD
- Channels | 4CH each

Low Temp. Pack Chamber



- Reliability Test Chamber EA

- Specifications

- Volume | 6000ℓ
- Temp. Range
-40°C ~ 60 °C
- Dimension | 3000 x 2000 x 1000
- Rooms | 2EA each

5. Facility & Equipment



Normal Temp. Pack Chamber



- Reliability Test Chamber
- Specifications
 - Volume | 6000ℓ
 - Temp. Range
10°C ~ 60 °C
 - Dimension | 3000 x 2000 x 1000
 - Rooms | 2EA each

Normal Temp. Module Chamber



- Reliability Test Chamber
- Specifications
 - Volume | 2320ℓ
 - Temp. Range
10 °C ~ 60 °C
 - Dimension | 1400 x 1200 x 1000
 - Rooms | 2EA each

Chiller



- Bath Circulator 2EA
- Specifications
 - Volume | 60L & 30L
 - Temp. Range | -30 ~ 80°C & 5 ~ 30°C
 - Channel | 2CH each
 - Flow Range | 1.0 ~ 20ℓ/Min
 - Pump | 3 BAR

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Appendix. Battery Pack Quality Analysis (Example : Basic inspection)



Inspection items	Contents	Example
Visual inspection	· External : Inspect scratches, dents, cracks and damage caused by external impact, and assembly · Internal : Inspect inflow of moisture of foreign matters, burned marks, connectors, bolt corrosion, coolant leakage and assembly.	
Airtightness test	· Case : Connect the connector for airtightness after checking the upper case is fully installed. Inspect with airtightness equipment according to the prescribed method. · Coolant flow path : Inspect according to the prescribed method by connecting the airtightness equipment to the coolant flow path quick connector.	
Assembly torque Inspection	· Case : Total inspection of case tightening bolt torque value · Module busbar : Total inspection of busbar tightening bolt torque value connected to module	
Insulation resistance	· Pack : Measure (+) and (-) insulation resistance of the entire system, respectively. · Module : Measure (+) and (-) insulation resistance for each module, respectively.	
Cell voltage	· CAN communication Test : Check it by connecting a diagnostic device to the low voltage connector · Cell voltage deviation : check if it meets the criteria	

Appendix. Battery Storage/Management



Classification		Remarks	Details
Temperature management		Below 30°C	- Using Air Conditioner - Real-time temperature log management according to temperature sensor and controller.
Preservation of battery product value		Stored Battery Recharging Service	- Inventory check and suitability assessment or stored batteries (perform re-evaluation/charging)
In case of fire		-	- Equipped with fire alarm system, smoke exhaust system, automatic fire extinguishing system and external/internal fire extinguishing equipment, Thermal Imaging Camera monitored by central control office in South Korea
In case of Emergency	Collision /small fire	-	① Elimination of ignition sources in adjacent area (flames, sparks, etc.) ② Removal of the electrolyte using a dry sand cloth with putting on personal protective equipment ③ Adequate ventilation  Class D fire extinguisher (for metals)
	Fire [Case A]	-	① Preparation and transfer the fire blanket ② Cover the battery pack fire blanket ③ Shut-off the oxygen  Fire blanket
	Fire [Case B]	-	① Prepare to extinguish the fire after putting on a gas Mask and protective equipment. ② Use a portable water tank after extinguishing the fire using a Class D fire extinguisher.  Portable water tank (Scheduled to be introduced)

Appendix. Development of Remanufacturing Technology



- When OEM releases a new vehicle model, POEN receive communication analysis information from OEM's R&D division, and establish the systems to build CAN signal analysis tools/interfaces, etc.

BMS Communication signal analysis

BMS communication signal analysis and diagnostic DB establishment

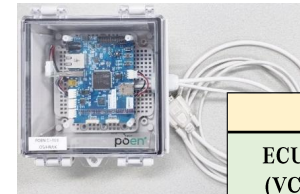
- Check BMS CAN ID communication connection
- Completion of CAN Database establishment for signal analysis
- Battery Pack communication signal analysis and confirmation of diagnostic message transmission and reception

Time	Chn	ID	Name	Event Type	Dir	DLC	Data
000	245,043	CAN 1 5D5		CAN Frame	Tx	8	00 00 00 00 00 00 00 00
000	245,918	CAN 1 595		CAN Frame	Tx	8	00 00 96 C0 F4 01 CD 0C
000	353,837	CAN 1 594		CAN Frame	Tx	8	00 00 00 00 80 82 00 00
000	353,801	CAN 1 596		CAN Frame	Tx	8	00 00 00 00 00 00 00 00
000	353,684	CAN 1 291		CAN Frame	Rx	8	00 00 00 00 00 00 00 00
000	353,684	CAN 1 523		CAN Frame	Rx	8	08 00 00 00 00 00 00 00
000	353,685	CAN 1 524		CAN Frame	Rx	8	00 00 00 00 00 00 00 00
000	353,686	CAN 1 200		CAN Frame	Rx	8	00 00 00 00 00 10 00 00
000	353,733	CAN 1 7E4		CAN Frame	Rx	8	02 10 03 00 00 00 00 00

BMS communication interface development

Self-developed BMS communication interface

- ECU Simulation : Vehicle simulation signal transmission
- Diagnostic function : BMS status information transmission

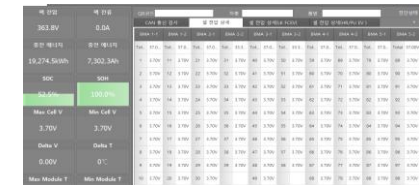


CAN Communication Interface	
ECU Simulation (VCU, MCU ...)	Diagnostic Function

Program Development

Self-developed Battery control/monitoring program

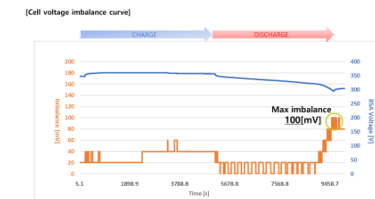
- Main relay control, cell voltage and temperature monitoring
- BMS information monitoring such as SOC, SOH, Error Code and battery saver function
- Battery information storage and CAN interface connection function



Battery Pack assessment & diagnosis

Battery diagnosis by analyzing Battery cycling data

- Check cell deviation in SOC range and measure battery capacity
 - Voltage, temperature, DC-IR data analysis by vehicle model/driving distance
- Evaluation of Battery Pack information by vehicle type and accumulation field data



Appendix. Patents / Certificates / MOU / Awards



Patent



Patent



Patent



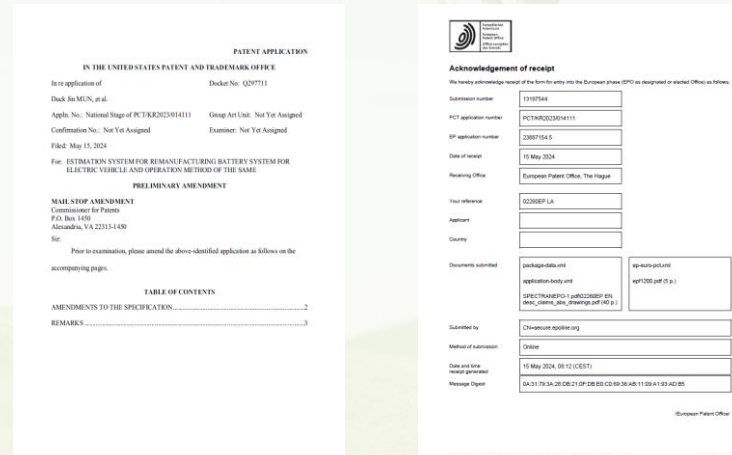
Patent



Patent



Patent



USA Patent Application



EU Patent Application



China Patent Application



Republic of Korea Patent Application

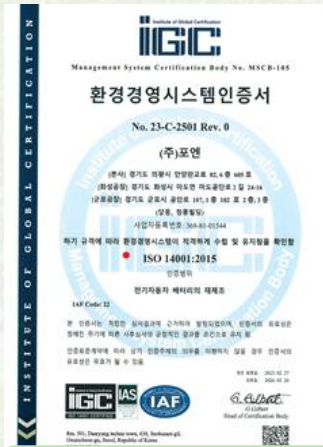
Appendix. Patents / Certificates / MOU / Awards



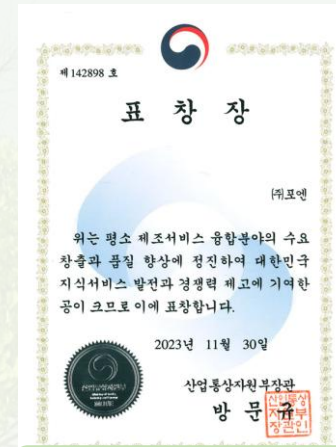
ISO 9001



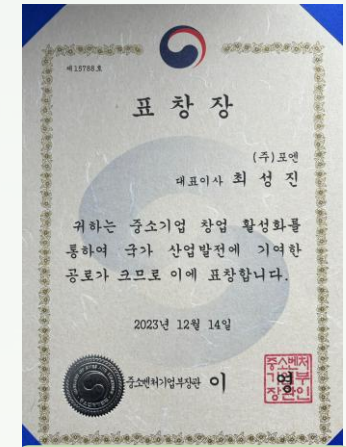
ISO 45001



ISO 14001



Minister of Trade, Industry, and Energy Award



Minister of SMEs and Startups Award

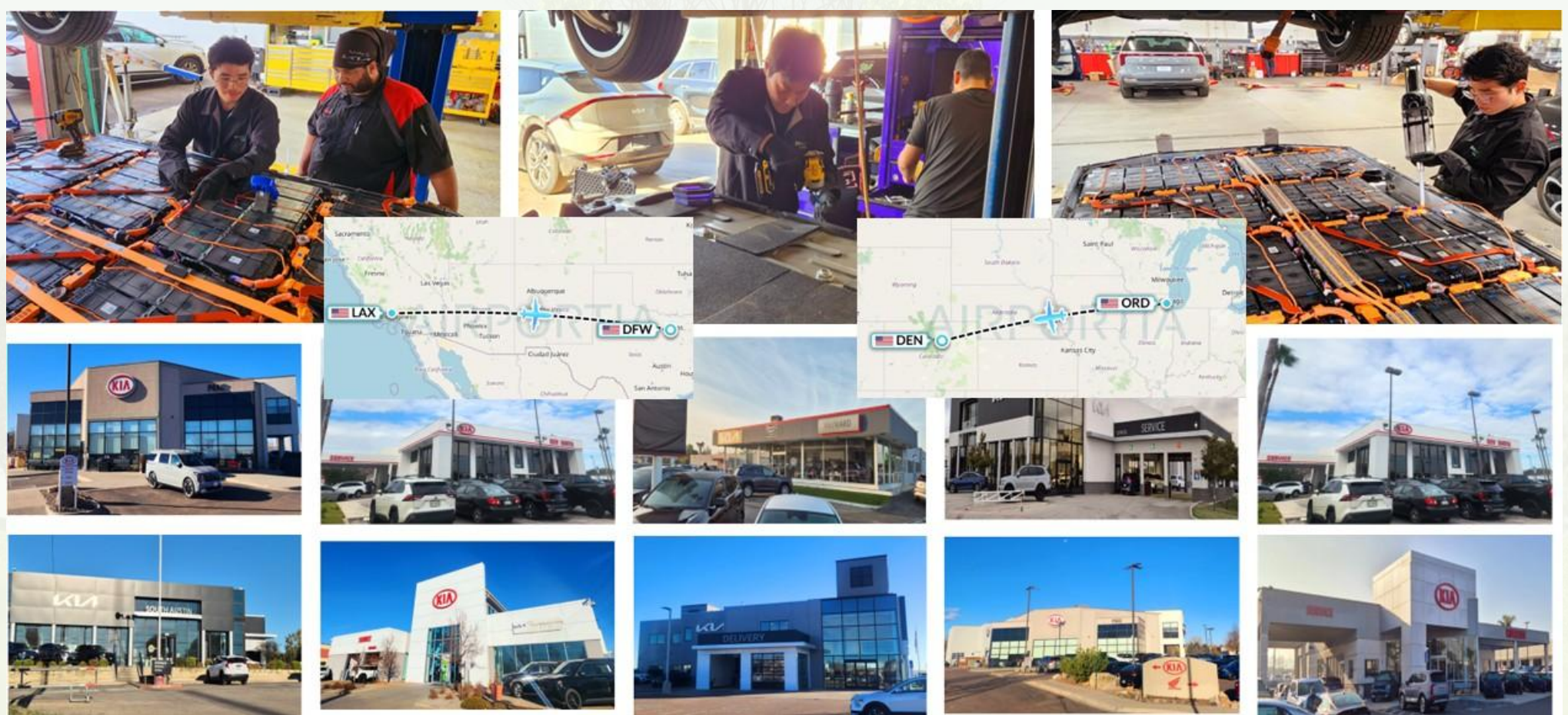


CES 2024 innovation award



Interbattery 2024 Best Innovation Award

- As the reliable partner for EV OEM, POEN goes every state in USA to support KIA's dealers.
- POEN is committed to traveling anywhere in the world to solve EV-related issues.



“ We hope that even the last appearance of
the Green EV will stay eco-friendly till the end ”

Contact:

SangUk Lee
Shaper for postive energy

poen'



Sulee@poen.co.kr

