MLTM
Ministry of Land, Transport and Maritime Affairs

TS

Status of Korean EVs Regulations and Activities

2nd EVE IWG Meeting

Baltimore, MD

September 13, 2012

Dongseok CHOI

Korea Automobile Testing & Research Institute

Contents

1 KATRI's research capability

2 Korean research activities for EVs

3 Status of Korean EVs regulations

4 Suggestion for power of traction battery

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KATRI's Research Capability

Major Work

- **Vehicle Safety Standards Research**
- **International Cooperation & Harmonization**
- Support & Development Government Policies
- **Defects Investigation**
- New Car Assessment Program(NCAP)
- Research to Improve vehicle Safety
- Technical Review & Safety Inspection
- Certification Tests For Emission & Noise
- Support Vehicle Industry

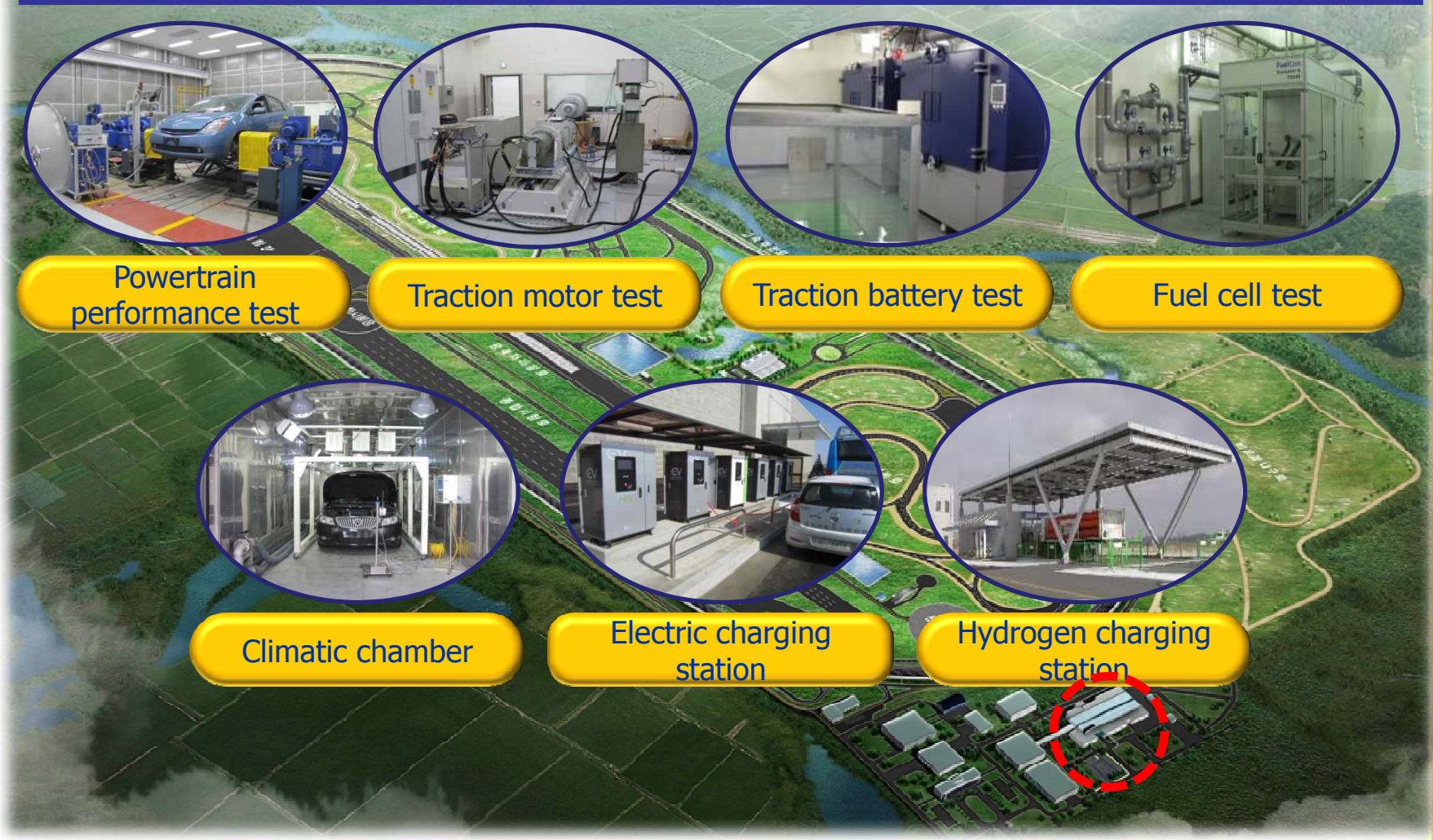
KATRI : *Korea Automobile Testing and Research Institute*

KATRI's Research Capability

- Total Area : 2.15 Mm^2
  - ① Main Office B/D
  - ② Veh. Inspection / Lighting Test
  - ③ Crash Worthiness / Avoidance Test
  - ④ Performance Test (E/G, Chamber, Emission)
  - ⑤ Noise/EMC Test
  - ⑥ Static Rollover Test
  - ⑦ Future Veh. Test B/D for HEV, PHEV, EV, and FCEV
  - ⑧ Proving Ground

KATRI's Research Capability

Test Facilities for EVs and FCEVs



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Korean EVs Research Activities

1. Research on the development of safety-Assessment Procedures for HEV

Objective	Amendment of the Safety standard for HEV
Period	Oct. 2006 ~ Sep. 2008
Participant	KATRI, SK Innovation, KESCO, MANDO
Task	· Safety standards will be applied according to performance test procedures for HEV to find out problems and solutions · Amendment of the safety standards for HEV · Power performance, Braking ability, Accelerator control system Defrost and demist, EMC, Crashworthiness, High voltage system and Traction battery
Result	· Amendment of KMVSS (8 Articles) : Jan.23,2009 - Amendment : Article 2(Definitions), 11(Motor and Transmission System), 15(Brake System), 91(Fuel System), 111(Motor Power) , 111-2(EMC) - Newly added : Article 18-2(High voltage electric device), 18-3(Traction Battery) · Amendment of KMVSS Test Procedure (7 Items) : Feb.19,2009

Korean EVs Research Activities - continued

2. Research on the development of safety-Assessment Procedures for FCEV

Objective	To amend safety standards for HFCV and consequently reflect research results to vehicle management policy
Period	Dec. 2007 ~ Dec. 2012
Participant	KATRI, HMC, SNU, SKKU, KESCO, YURA CO. etc.
Task	· Development of a technique for safety assessment of FCEV - Regulation system and policy - Research for safety of hydrogen storage and supply system - Assessment of compliance with safety standards of FCEV - Research for electric safety of high-voltage and fuel cell system · International harmonization of safety standards for FCEV · Development of safety standards for hydrogen storage, supply system and fail safety
Result	· Amendment of KMVSS (10 Articles) : in 2012 - Article 17(Fuel System), 18-2(High voltage electric device),37(Muffler), 87(Accelerator Control System), 90(Brake System), 91(Fuel System), 102(Occupant Protection), 109(Defrost and demist), 111(Motor Power, TB power, Fuel cell power) , 111-2(EMC) · Amendment of KMVSS Test Procedures (15 Items) : in 2012

Korean EVs Research Activities - continued

3. Monitoring Program of EVs

Objective	Identify problems regarding safety and develop the plan of improvement during field monitoring
Period	Apr. 2010 ~ Dec. 2012
Participant	KATRI
Task	▪ Monitoring of EV during real world monitoring - Monitoring Vehicle : NEV(10), EV(7), EV Bus(1) - Monitoring region(8) ・Traffic environment : big city, towns, rural, sea-side village, mountain village ・Climate condition (term) : consider annual temperature variations, etc. ▪ Activation and Ensure the safety of EV - Identify field problems and solutions ▪ Amendment of Motor vehicle safety standards for EV - In-use(Charging) : EMC and Safety of High voltage electric device - Fuel Economy test procedure for Heavy Duty Vehicle(including EV) - Test Procedure of Traction Battery Safety
Result	・Amendment of KMVSS Test Procedure(3 Items) : 2012~2013

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Status of Korean EVs Regulations

KMVSS (Regulation on Korea Motor Vehicle Safety Standard)

- **Promulgation : Jan. 23, 2009** ☞ Result of Research on HEV Safety

Article	Description	Remark
Article 2 Definition	**52. High voltage electric device, 53. Traction Battery, 54. Traction motor, 55. Live parts**	**-**
Article 18-2 High voltage electric device	**Safety for high voltage electric device** (Isolation, Protection against indirect contact)	**EVS item** Plan to Amend in 2012 by result of research on FCEV safety
Article 18-3 Traction Battery (RESS)	**Safety for traction battery**	**EVS item**
Article 91 Fuel System	**Safety for high voltage electric device after collision test**	**EVS item**
Article 111 Engine Power	**Power of ICE and traction motor** (To be added the power of traction battery and fuel cell)	**EVE item** Plan to amend in 2012 by result of research on FCEV safety
Article 111-4 Fuel Consumption Rate	**Fuel economy , Energy efficiency Vehicle range**	**EVE item**

Status of Korean EVs Regulations

KMVSS Test Procedure

- **Promulgation : Feb.19, 2009** ☞ Result of Research on HEV Safety

Article	Description	Remark
Annex 1 -Part 23 Test Procedures of engine power	· Application : HEV, PHEV, EV, FCEV · Test items : power of ICE and Traction motor · Test Procedure - Net power test - Max. 30 minutes power for traction motor	Similar to UN Regulation No. 85

- **Plan to amend in 2012** ☞ Result of Research on FCEV Safety
  - **Test Procedures of Power of Traction Battery and Fuel cell for HEV, PHEV, EV and FCEV**

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Motivation for Power Test of Traction Battery

1. **The power test of a traction motor uses a external power source.**

   (UN Regulation No. 85)

   -> There is no regulation for checking the power of traction battery.

> 5.3. Description of tests for measuring the net power and the maximum 30 minutes power of electric drive trains
> The electric drive train shall be equipped as specified in annex 6 to this Regulation. The electric drive train shall be supplied from a DC voltage source with a maximum voltage drop of 5 per cent depending on time and current (periods of less than 10 seconds excluded). The supply voltage of the test shall be given by the vehicle manufacturer.

2. **The test method has to be determined from discharge patterns of vehicle test.**

   -> Constant power test is more realistic than constant current test.

Comparison between Several Standards

Items	ISO 12405-1	SAE J1798	CP* test
Description	International Standard	US Standard	Maker test method
Enacted year	2010	1997	-
Test unit	System	modules	System
Test method	- Test profile - Constant current discharge	- Test profile - Constant current discharge	- No test profile - Constant power discharge
Characteristics	- Different power at SOCs - Different discharge pattern comparing vehicle discharge	←	- Easy to determine max. power

*** CP : Constant Power**

Test Devices

PNE450 /400

- Voltage/Current : 450V DC / 200A DC
- Power : ±90kW
- Channel No. : 2CHs
- Working mode : CC / CP / CR / CC-CV mode

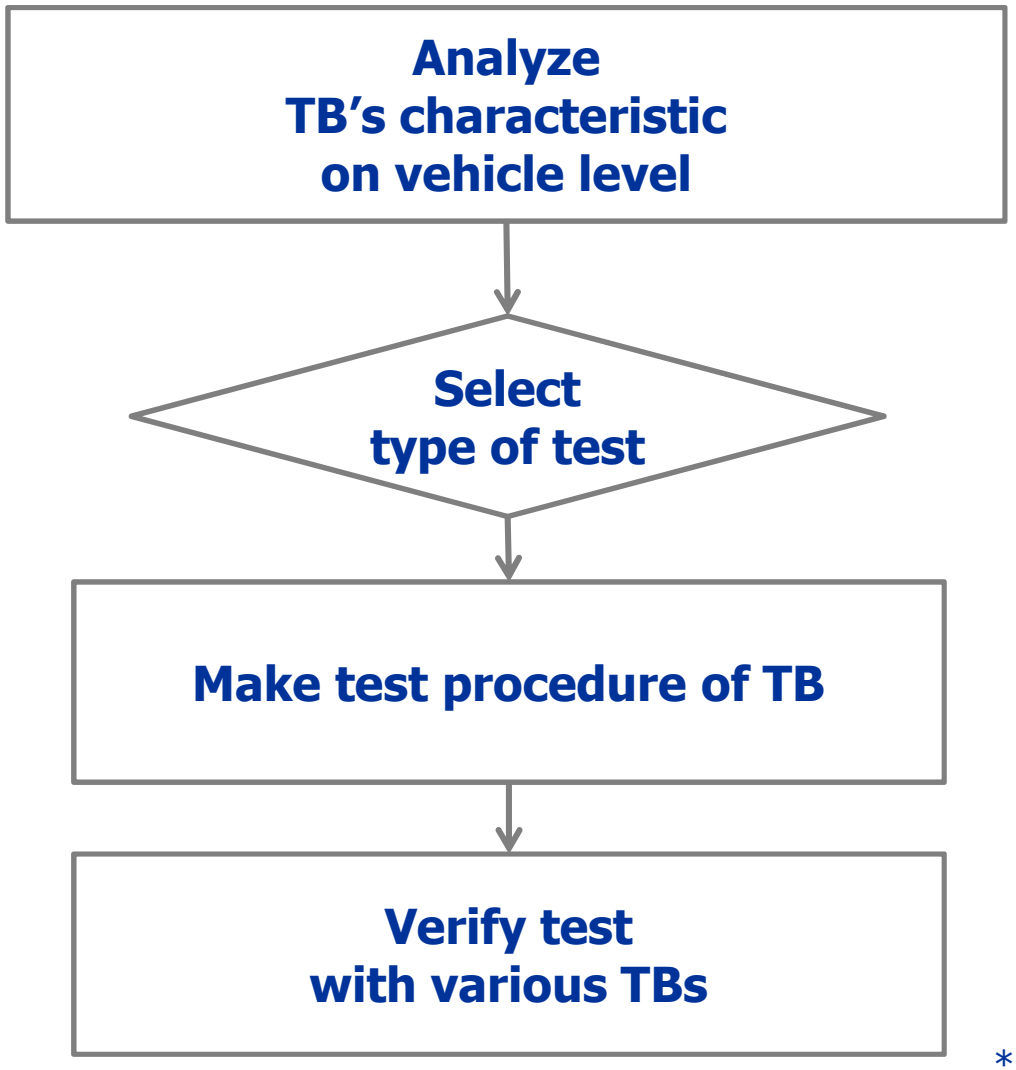
PNE1000 /50

- Voltage/Current : 1,000V DC/ 50A DC
- Power : ±150kW
- Channel No. : 1CH
- Working mode : CC / CC-CV mode

ABC 600

- Voltage/Current : 600V DC/ 300A DC
- Power : ±150kW
- Channel No. : 2CHs
- Working mode : CC / CP / CR / CC-CV mode

Development Flow for Test Procedure of TB



* TB : Traction Battery

Test Setup for Vehicle Level Test

EV
Max Motor power : 50 kW
Battery capacity : 330V/50Ah

HEV
Max Motor power : 30 kW
Battery capacity : 270V/5.3Ah

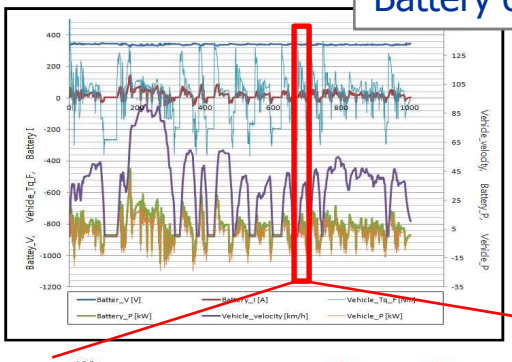
- **Vehicle data from Powertrain test bed**
  - Wheel Torque of vehicle
  - Speed of vehicle
  - Power of vehicle

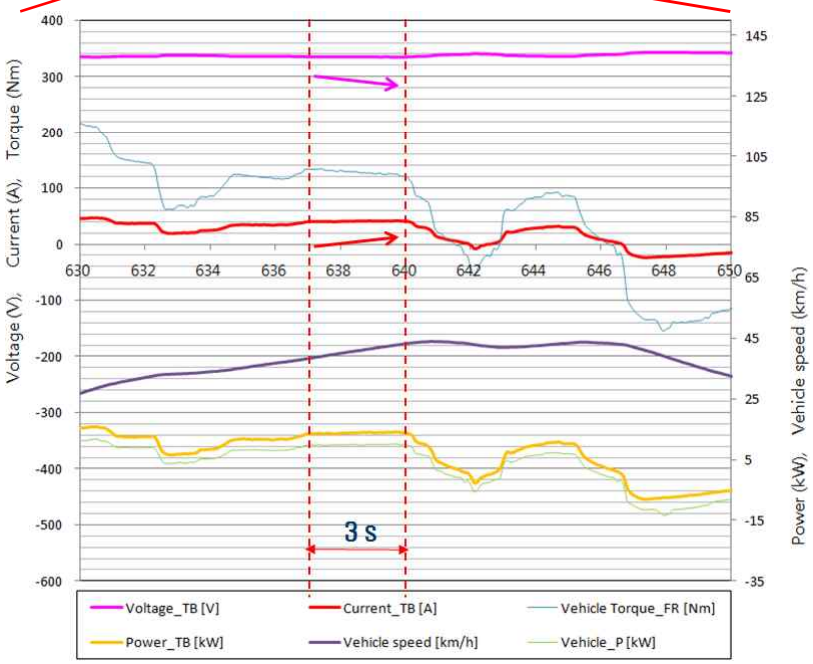
- **Traction battery's Data from DAQ**
  - Voltage of TB
  - Current of TB
  - Power of TB

Test of Vehicle Level (Driving cycle)

EV

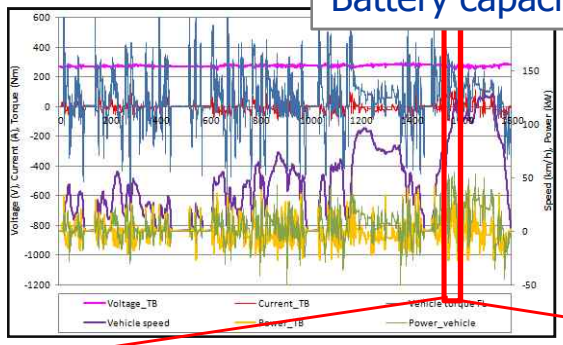
Max. Motor power : 50 kW
Battery capacity : 330V/50Ah

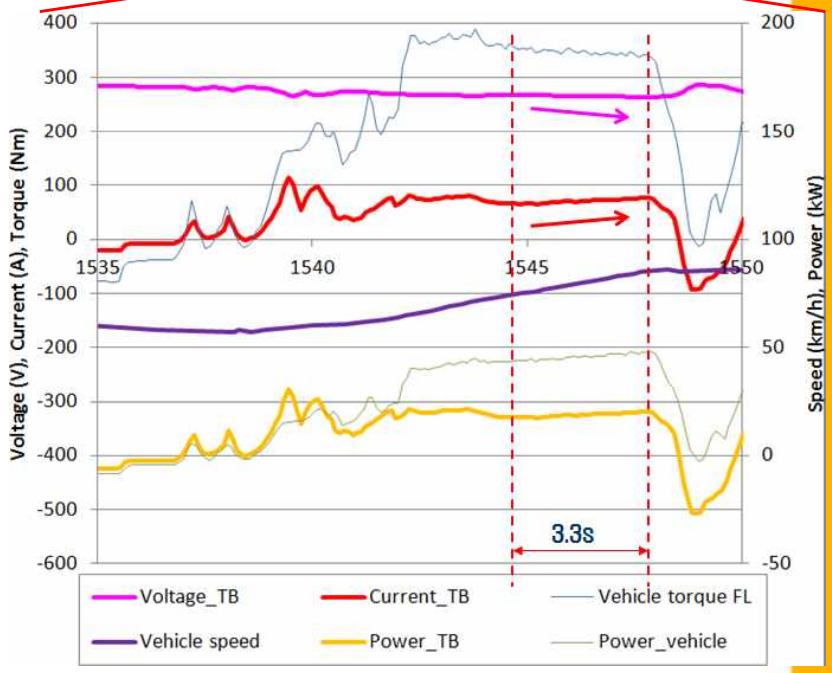




HEV

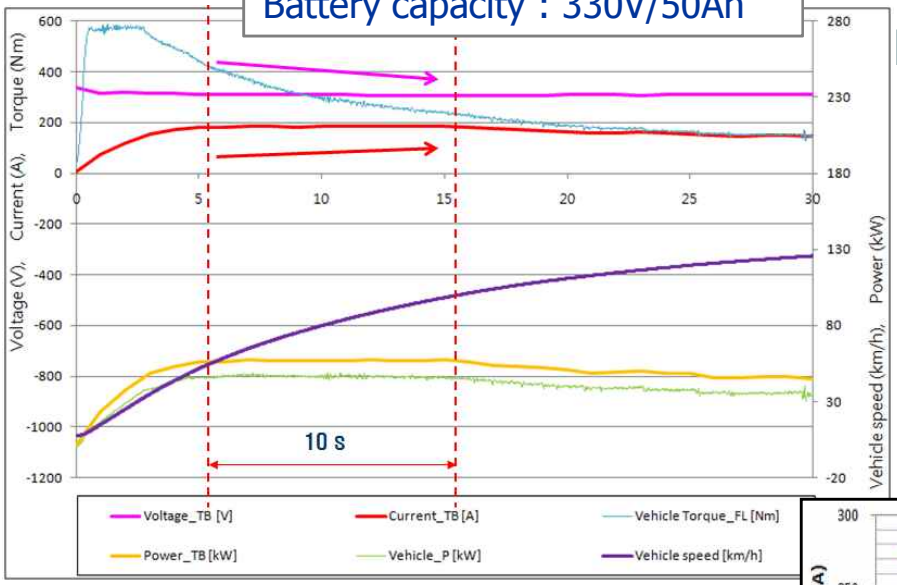
Max. Motor power : 30 kW
Battery capacity : 270V/5.3Ah





Test of Vehicle Level (Full Load Test)

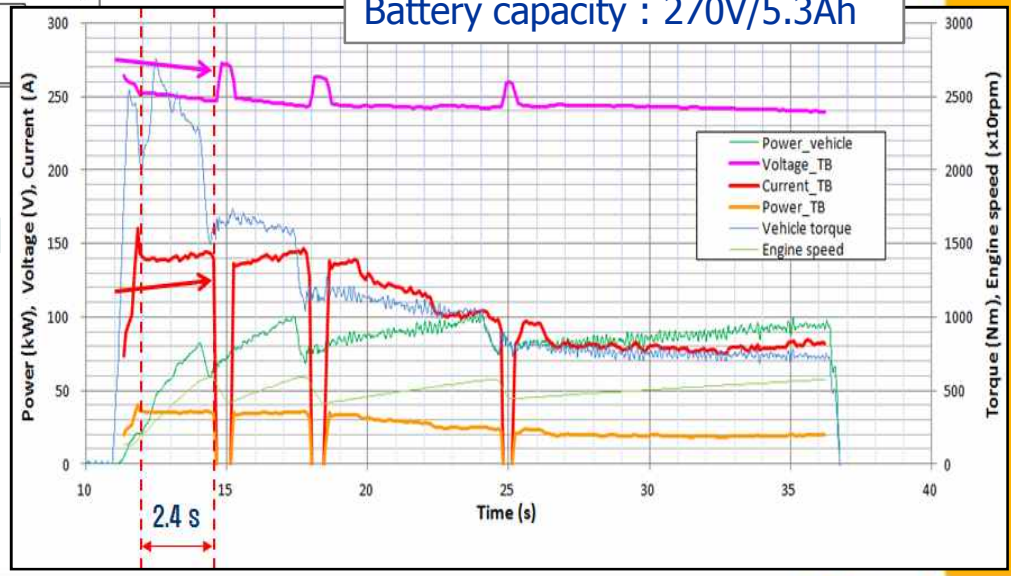
Max. Motor power : 50 kW
Battery capacity : 330V/50Ah



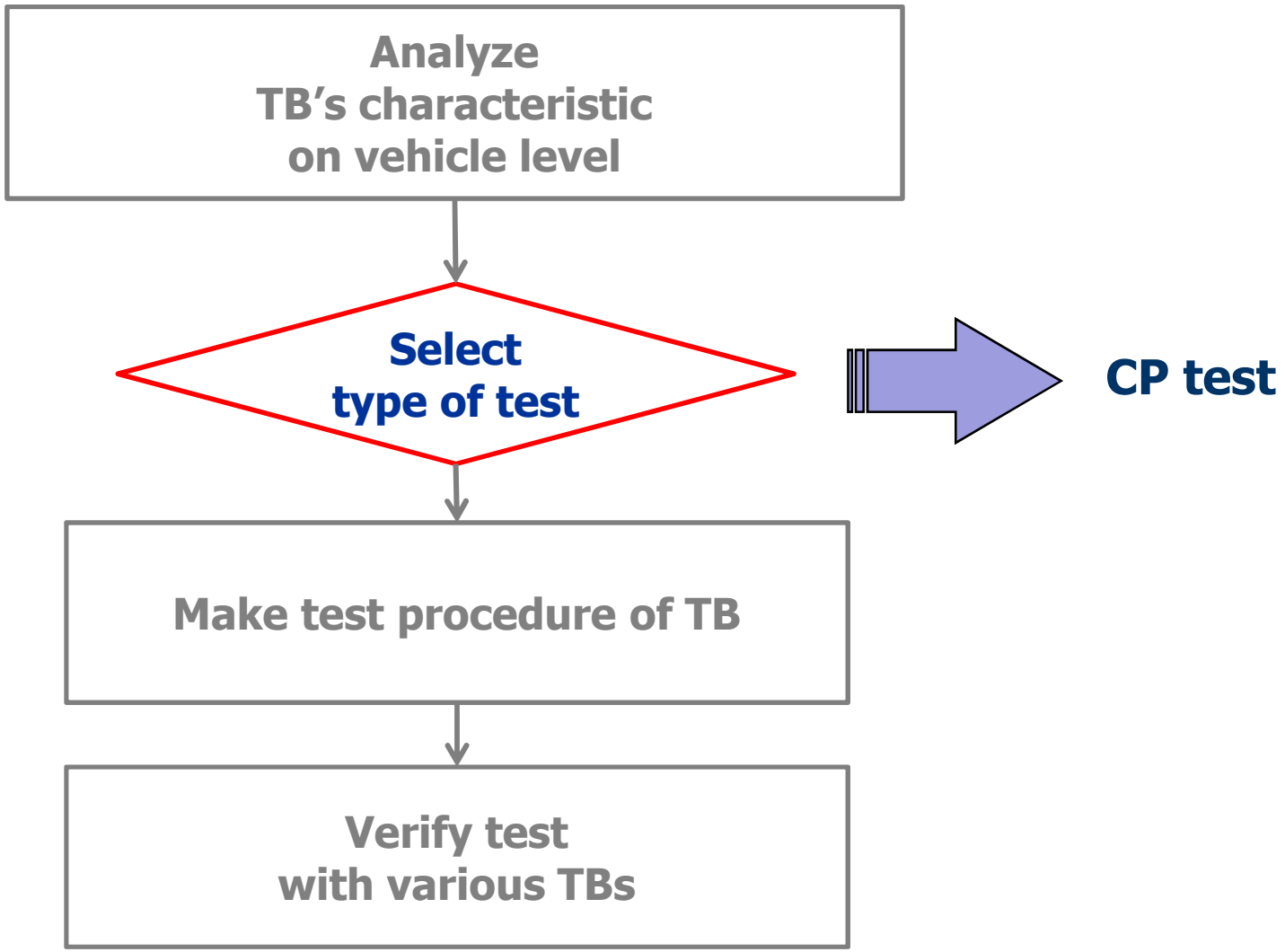
EV

Max. Motor power : 30 kW
Battery capacity : 270V/5.3Ah

HEV



Development Flow for Test Procedure of TB

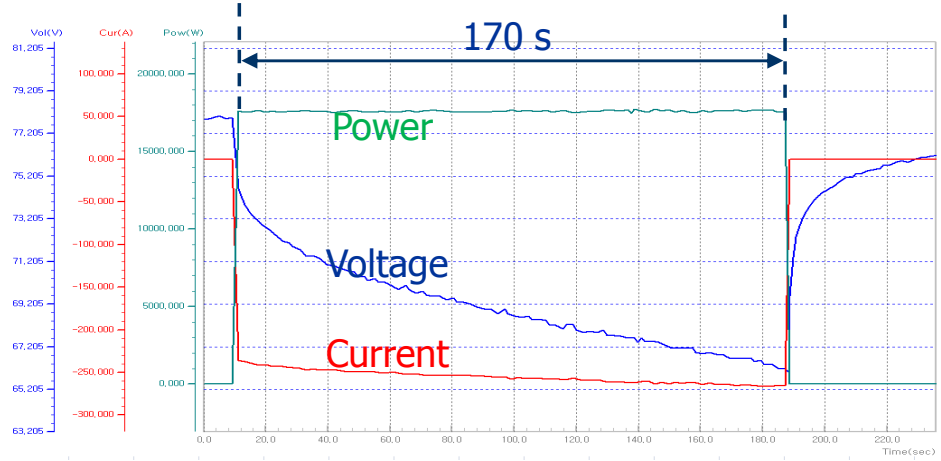


Specification of Batteries for CP Test

DUT-A (High Energy)		DUT-B (High Power)
		
Li-ion	Type	Li-polymer
3(par.) x 24(ser.)	cell × module	8(ser.) x 6(ser.)
76.8	Nominal voltage (V)	180
120	Nominal capacity (Ah)	5.3
9.2	Nominal energy (kWh)	0.954
2C, 240A	I_{max} (A)	20C, 106A
17.6 (SOC 80%, 5 sec)	Max. power (kW)	17.8 (SOC 30%, 5 sec)
-20 ~ 55	Working Temp. Range (℃)	-40 ~ 65

Test Results

< High-energy battery >

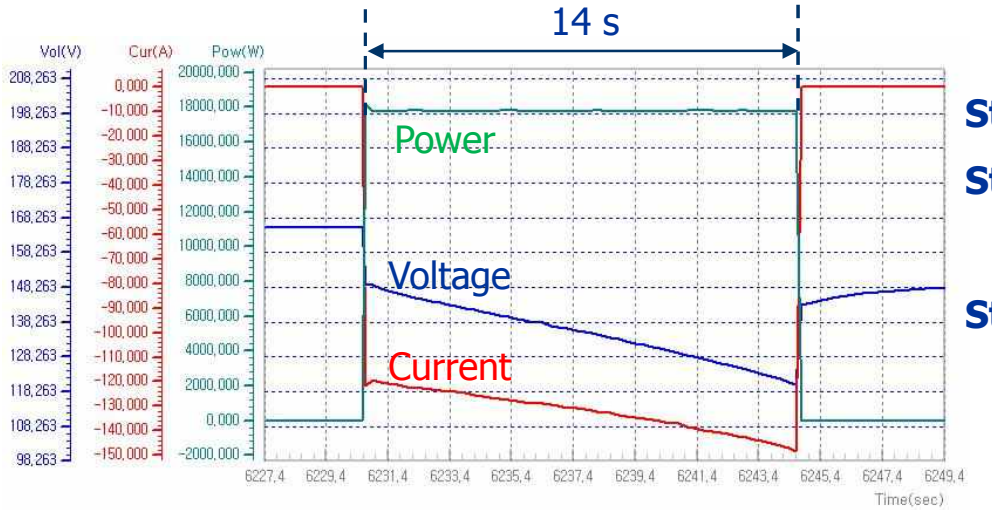


Step 1. Check rated capacity (120 Ah)

Step 2. Set SOC 80% by discharge after full charging

Step 3. Discharge at 17.6 kW to the end voltage of discharge

< High-power battery >



Step 1. 5. Check rated capacity (5.3 Ah)

Step 2. Set SOC 30% by discharge after full charging

Step 3. Discharge at 17.8 kW to the end voltage of discharge

Summary and Future Plan

< Test Procedure for Traction-Battery Power >

Step 1 : Test Voltage, SOC, and discharging time shall be given by manufactures.

Step 2 : Check rated capacity of test battery three times.

Step 3 : Set the given SOC by discharging after full charge.

Step 4 : Discharge by the maximum Power during the given discharging time.

Step 5 : Report the test result.

< Future Plan >

To verify the test procedure for various types of TBs

Thank you
for your attention!

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