

Japan Comments for Battery Durability GTR

29.June.2020

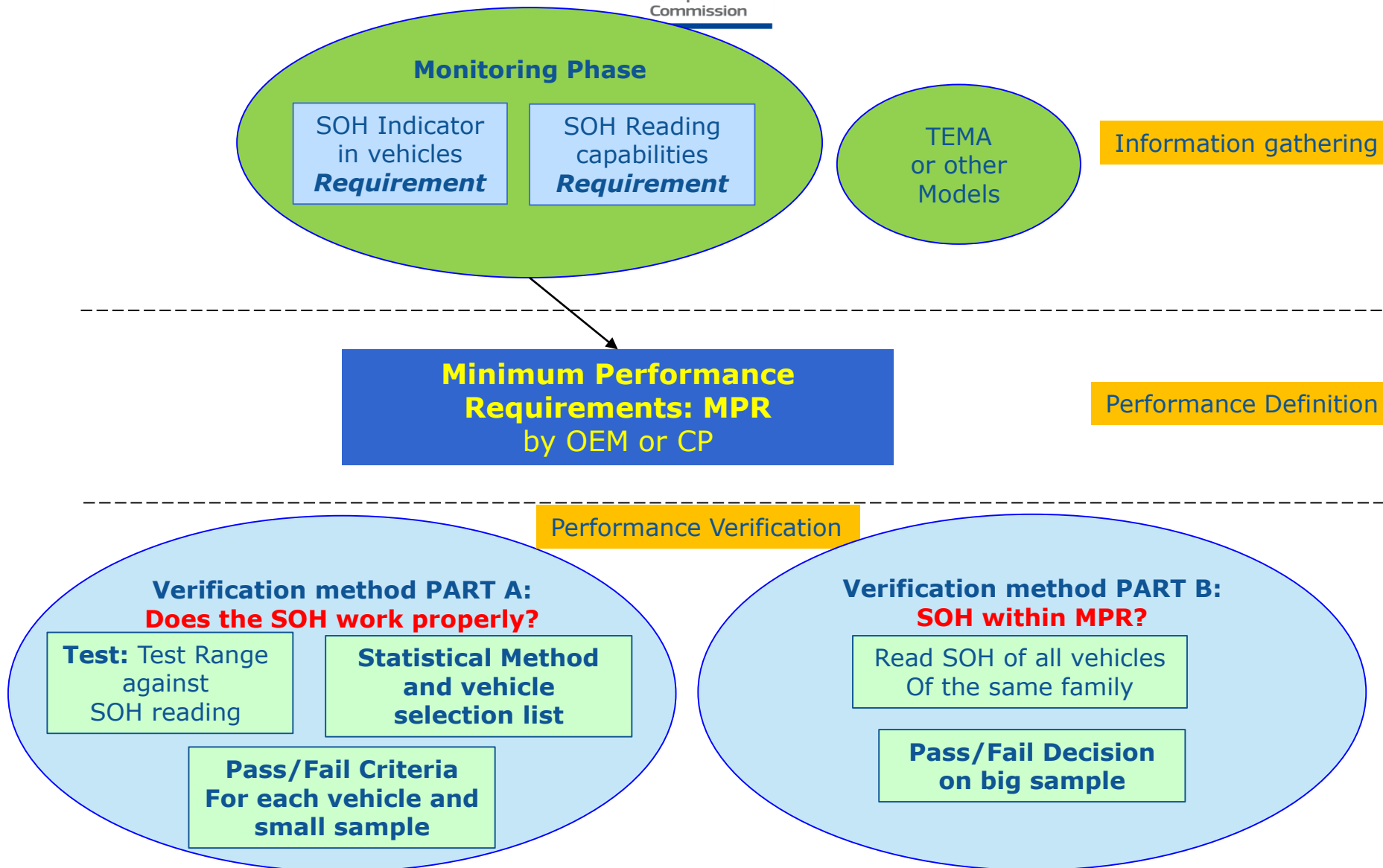
Current DRAFT framework for Phase 1

Quoted from GRPE-81-32

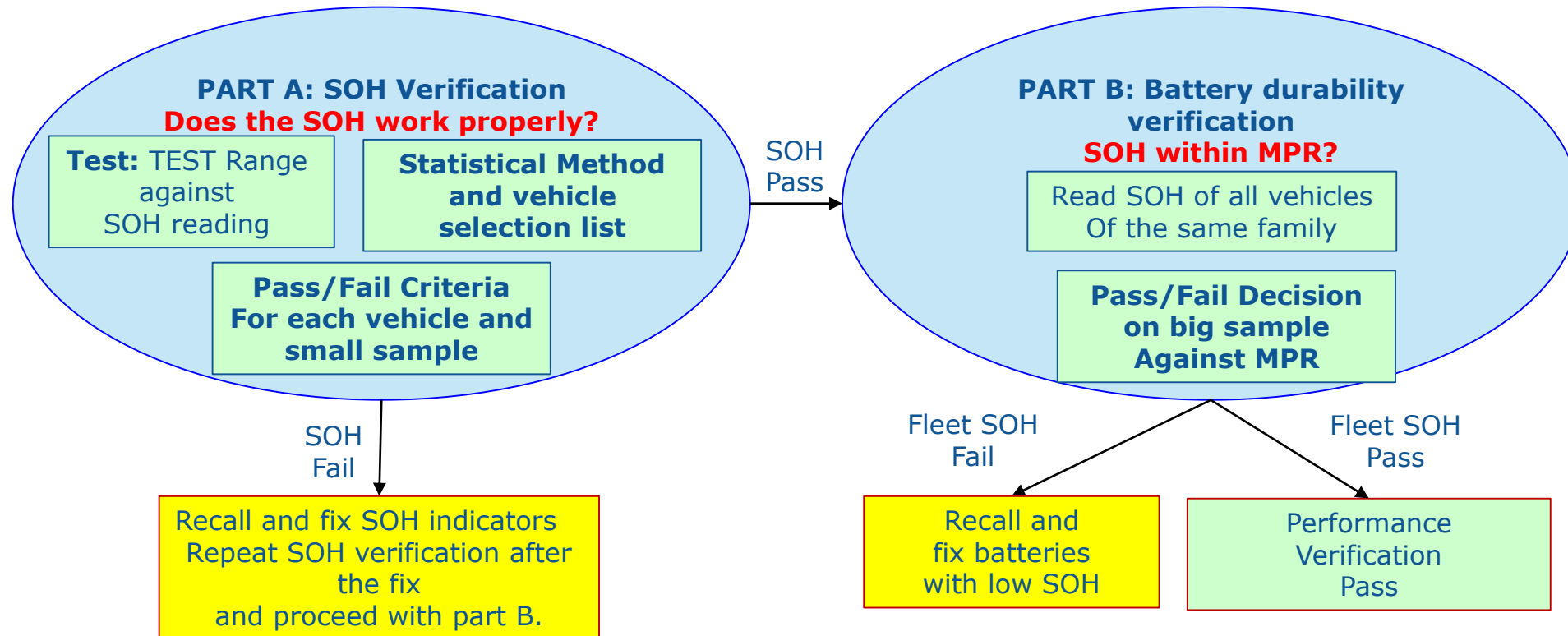
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1. **Minimum performance requirement (MPR)**
 - **Percentage retention** of certified range [or capacity] “**x**” years and/or “**y**” distance
 - MPR is applicable to all manufacturers
 - Individual manufacturers can declare a better performance (declared PR, or DPR)
2. **Onboard battery state-of-health (SOH) metric**
 - Definition of SOH = (Remaining range / certified range) [**or based on capacity?**]
 - OEMs responsible for their own algorithm
 - Readable by responsible authority (via OBD or similar)
3. **In-service conformity (ISC) and data collection**
 - Part A: Establish reliability of SOH metric
 - ✦ Small sample of 3-10 vehicles via ISC
 - ✦ Use checklist/survey to exclude vehicles with abnormal usage
 - ✦ Measure range via range test used for type approval (commonly, WLTC)
 - ✦ **Verify accuracy of SOH metric by comparing to measured range**
 - Part B: Determine conformity with MPR / DPR
 - ✦ Large sample of unspecified number of vehicles (may remove need for NUIs)
 - ✦ Routine collection of SOH metric, e.g. at safety inspections or via telematics
 - ✦ Determine conformity by reference to collected SOH
4. **Establish mechanism for ongoing data collection to inform Phase 2**
 - Primarily SOH collection
 - **Identify simple NUIs that can be implemented now**, if any
 - Discussion may be started in Phase 1 under limited samples

Improved proposal



Battery Performance Verification



PART B: Data collection

- *Data collected yearly from all registered vehicles*
 - **During Periodic Technical Inspection**
 - **Over the air**
- *Appropriate yearly analysis to show if fleet SOH is above the Minimum Performance Requirements*
- *Might be necessary to define MPR targets that vary with the age of the vehicle, not only the final target*
- *Recall may be necessary for those vehicles with SOH below MPR only*

JAPAN Proposals and Comments

1. SOH Terminology Definitions

- 1) **SOH _ test** : Obtained from ISC test results
- 2) **SOH _ indicator**: Output value from the OBD port or readable information calculated by the internal information of the ECU.

2. Determination of the allowed range or capacity variation in ISC Part A (X %)

- 1) Develop fixed value in GTR. (Not decided by each CP)
- 2) JAPAN will provide the Information of "ECU measurement variation"
and EVE Task Force will discuss and decide "the allowable variation" based on the data (P.9).
- 3) The range method and the capacity method can be used for verification. Since they are nearly equivalent values, both should be allowed, but capacity method has less variation (P.10)

3. Determination of MPR

- 1) Not acceptable to have multiple MPR targets.
The chemical properties of Li_B do not cause linear degradation, and no time for data collection.
At least multiple MPR should not be introduced on Phase1.
- 2) It is important to make a discussion based on technical grounds and to decide the method to determine MPR with stakeholders in EVE

4. NUI

Although the priority has been lowered, EVE members will discuss and decide the information that should be included.

5. Concerns that the Li battery degrades quickly in the initial stage. (Page 11)

Need to share this issue and Discuss how to manage at the EVE.

Since the initial degradation of the Li battery is rapid and large, SOH indicator might cause user anxiety.

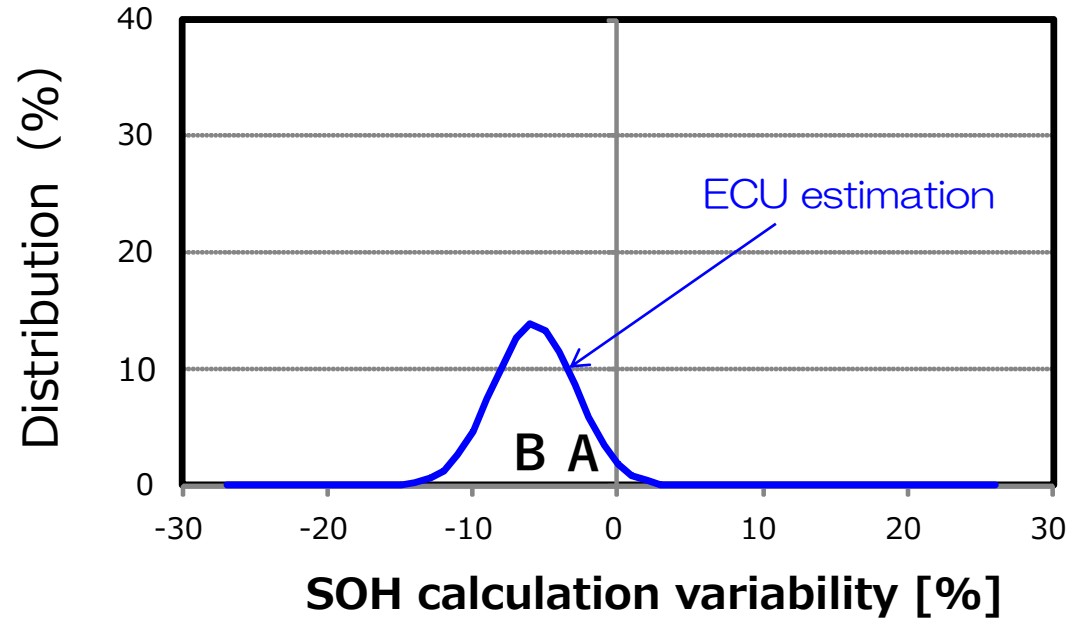
About the initial degradation,

- (1) Need to communicate to consumers appropriately.
- (2) Since consumers are not necessarily able to understand it, the SOH indicator system should be designed so as not to raise concerns about initial degradation.

ECU estimation accuracy of SOH

Quoted from EVE-34-15e

2012MY Prius PHV (previous Model)



Current model has not recovered yet

[%]	-99 Percentile	Average	+99 Percentile
Calculation error in in-vehicle ECU	-12.0	-5.3	1.4

Variation factor of capacity in ECU

1. Current and voltage sensors
2. Characteristic deviation of SOC-voltage relationship
3. Other, such as conservative estimation...

In the previous model, SOH in the in-vehicle ECU is lower than the measured true value by 5% on average and varies in a range of about 15%. Accumulating design tolerance further increases the variation.

Note; Vehicle A and B are within this variation.

JARI Validation Test results (Prius PHV & Leaf)

Quoted from EVE-34-15e

- 1.Verification of consistency between SOH indication value and battery capacity degradation by the range and capacity method
- 2.analysis of variation

表1 プラグインハイブリッド車のばらつき解析結果

Prius PHV		JC08 N=1	JC08 N=2	1回目と 2回目の difference	1回目と2回 目の 割合	1回目 の差 (RMSSE)	Difference of Drive Index の差 (IWR)
EV range	Vehicle A	65.8km*	68.5km	2.7km	4.1%	0.03km/h	0.08%
	Vehicle A With compensation	67.8km	68.5km	0.7km	1.0%	0.03km/h	0.08%
	Vehicle B	68.8km	67.4km	1.4km	2.1%	0.02km/h	0.01%
AC Charge Amount	Vehicle A	6.14kWh	6.07kWh	0.07kWh	1.2%	-	-
	Vehicle B	6.09kWh	6.09kWh	0.00kWh	0.0%	-	-

*The vehicle was stopped for 40 minutes due to the emission analyzer trouble.

表2 電気自動車のばらつき解析結果

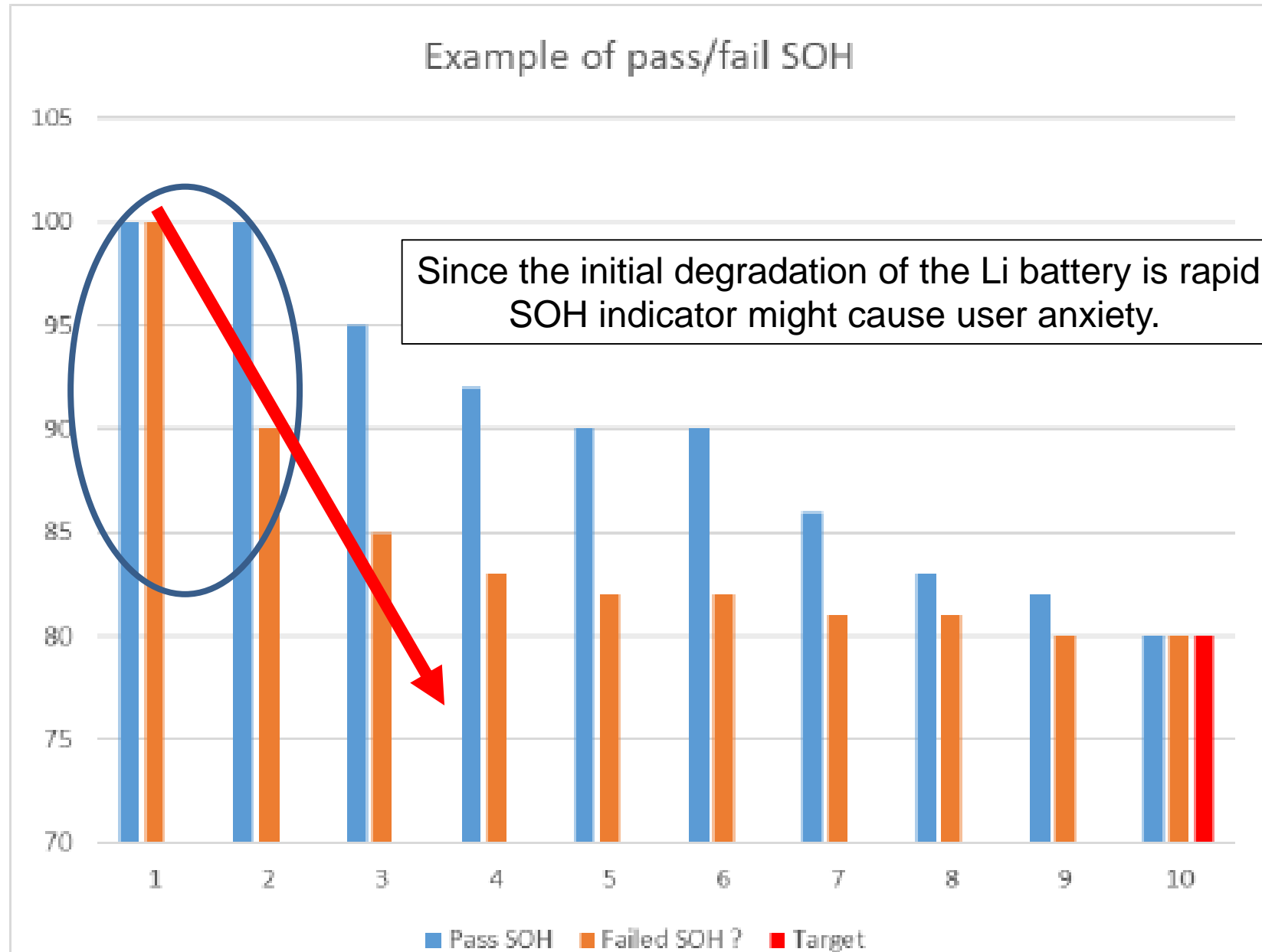
Leaf	WLTC N=1	WLTC N=2	WLTC N=3	最大と最少 Max. difference	最大と最少 割合
EV range 離 (4phase)	262km	255 km	255km	7km	2.7%
AC Charge Amount	44.68kWh	44.67kWh	44.67kWh	0.01kWh	0.0%

Although the variation of the distance method is sufficiently low
The variation of the capacity method is even smaller.

Variation factor for Range method

- 1.driver's operation
- 2.acceptable operation within the WLTP

Pass or Fail Range/SOH: example



Appendix

JAMA Position

- 1. Since each OEMs are allowed to use their own algorithm for SOH in ECU calculation, definition or/and determination of capacity or range are not necessary**
- 2. As for the ISC verification, the range method and the capacity method are considered to be almost equivalent, and both should be accepted.**
 - 1) Electric consumption (Kwh/km) is required for conversion from the capacity (Kwh) to the range (Km).
The deterioration of the electric consumption (Kwh/km) is dominated by the increase of the internal resistance of the battery, and the degree of influence is negligibly small.
(See Presentation from Japan at EVE 34 and 35)**
 - 2) Regarding capacity, although UBE is superior in terms of technical accuracy, Eac should be chosen in terms of ease of measurement.
The conversion from Eac to UBE is expected to be affected by deterioration of the efficiency of the charger and deterioration of the accessory load over time.
The impact is estimated to be very small. Verification or confirmation is necessary in the future.
(See Presentation from Japan at EVE 34)**
- 3. Since the range method is more appropriate from the viewpoint of user's comprehensibility, additional explanation for " relation between capacity and range" is needed or preferable when verifying by the capacity method.**