

Safety philosophy for lithium ion HV batteries at Volkswagen

(Response to US's and other CP's request to provide more industry examples for dealing problems like thermal propagation)

Dr. Alexander Börger





Safety Requirements in the Development Process

The 4 main items of the safety philosophy for lithium ion HV batteries at Volkswagen:

battery electric vehicle

HV battery system

1. The system must be able to compensate each possible highest-rank cell failure that can occur..

HV battery cell module

2. The cell module is constructed in a way that a cell failure does not propagate. (A cell failure must never lead to rapid corrosion events.)

lithium ion cell

- 3. A cell failure cannot be excluded over lifetime and with millions of cells. Such a failure can occur with the highest Hazard Level that has been determined in corresponding tests (i.e., as a general rule HL 4).
- 4. Only in case failure modes can be excluded by methods like FTA or FMEA and this is confirmed by tests on cell module level, requirements can be dropped or tests can be done only "for information purposes".





Functional Safety

Hazard and Risk Analysis (HARA)



Thermal propagation on cell level

-> Possible malfunction on system level?

-> Hazard Level?

S

Severity of thermal propagation

How serious are the injuries?



Controllability of thermal propagation

Is the damage controllable?



Exposure of thermal propagation

When does the situation occur?



		C 1	C2	C 3
S1	E1			
	E2			
	E3			ASIL A
	E4		ASIL A	A ASIL B
S2	E1			
	E2			ASIL A
	E3		ASIL A	A ASIL B
	E4	ASIL A	ASIL E	B ASIL C
S 3	E1			ASIL A
	E2		ASIL A	A ASIL B
	E3	ASIL A	ASIL E	B ASIL C
	E4	ASIL B	ASIL C	ASIL D



