2nd use application of battery cells: functional safety requirements

Workshop: Regulatory Qualification Requirements for Battery Storages

March 3rd 2018

SGS TÜV SAAR

WHEN YOU NEED TO BE SURE SGS

SGS SGS TÜV SAAR

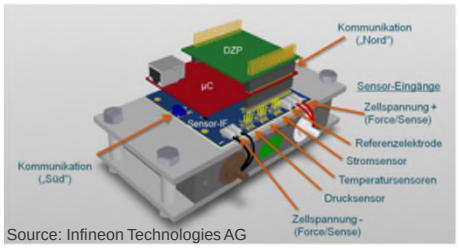
AGENDA

- Introduction of project MiBZ
- What means functional safety
- Standards for Functional Safety
- Comparison of functional safety requirements
- Outlook project results MiBZ

PROJECT MiBZ: MULTIFUNCTIONAL INTELLIGENT BATTERY CELL

funded project of Bundesministerium für Bildung und Forschung

- German federal funded project to research a multifunctional intelligent battery cell (MiBZ)
- PHEV2 NMC/ Graphite Cell
- Integrated sensors
- BC-Unit on cell level



Source: Infineon Technologies AG

- Digital cell pass to store specific battery information

CONSORTIUM PROJECT MiBZ

MiBZ

- BMW & VARTA-Storage (key user)
  - Definition of requirements
  - Demonstration, Validation and industrial evaluation
- VARTA MB (cell manufacturer)
  - manufacturing of „state-of-the-art" cells incl. developed functionality
  - Test & evaluation
- Infineon Technologies (supplier)
  - Sensors & electronics for analysis, communication and control
  - Functional model: digital cell pass
- SGS TÜV-Saar (testing organization)
  - Functional Safety (automotive & stationary)
  - Verification & Test
- FhG Institute for Integrated Systems and Device Technology
  - Communication between MiBZs and BMC
  - Sensorless cell temperature measurement and hybrid total current sensor
- Technical University of Munich
  - Condition monitoring, modelling and simulation
  - Test & Evaluation

PROJECT MiBZ: FOCUS FUNCTIONAL SAFETY

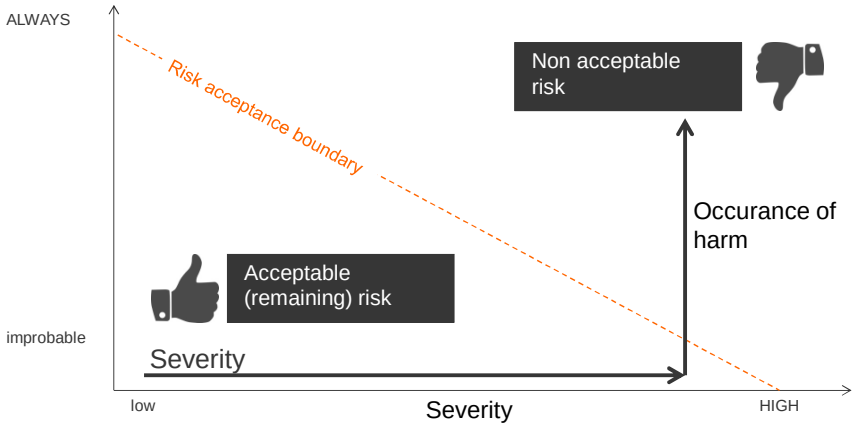
- SGS-TÜV examines the applicable standards for functional safety
- Comparison of requirements for automotive and stationary application to reduce development effort during the design phase of the MiBZ
- Assessment of the used electronic architecture
  → statement due to qualification of industrialization and early detection of conceptual relevant issues.

WHAT MEANS FUNCTIONAL SAFETY?

- Definition Functional Safety

absence of unreasonable risk due to hazards caused by malfunctioning behavior of E/E systems.

HAZARDS AND RISKS



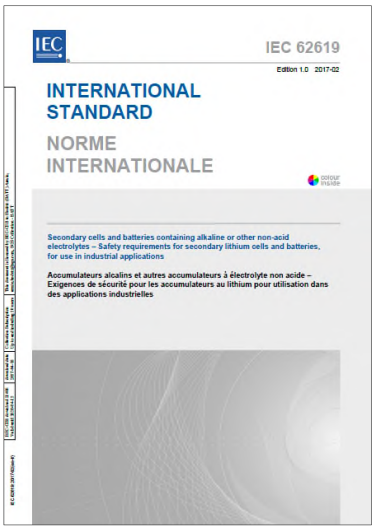
 7

REQUIREMENTS FOR STATIONARY APPs

- At project start it was not clear which standard for FS of a stationary app shall be used
- ICE 62619 is reworked and published in 02-2017
  - standard addresses: Safety requirements for secondary lithium cells and batteries, for use in industrial applications
  - For functional safety the IEC 62619 recommends IEC 61508
- In the project MiBZ a hazard analysis and risk assessment was carried out, result is a SIL incl. the necessary safety functions

 8

IEC 62619:2017


IEC 62619
Edition 1.0 2017-02
INTERNATIONAL STANDARD
NORME INTERNATIONALE
Secondary cells and batteries containing alkaline or other non-acid electrolytes – Safety requirements for secondary lithium cells and batteries, for use in industrial applications
Accumulateurs alcalins et autres accumulateurs à électrolyte non acide – Exigences de sécurité pour les accumulateurs au lithium pour utilisation dans des applications industrielles

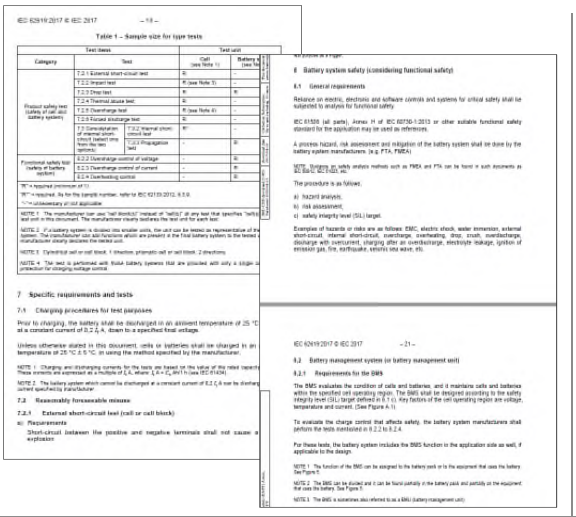


Table 1 – Sample size for type tests

8 Battery system safety (considering functional safety)

9.3 Battery management system (or battery management unit)

REQUIREMENTS FOR AUTOMOTIVE APPs

- since 11-2011 ISO 26262 is the relevant standard
- this standard is accepted and established in the automotive industry
- Specific requirements on top level are available for project MiBZ

Note:

2nd edition of ISO 26262 will be published mid of 2018. Scope of the standard extends to motorcycles, heavy duty vehicles and busses.

DERIVATION OF TOP LEVEL REQUIREMENTS

Safety related requirements are available for both apps on top level

- stationary app
  - Hazard analysis and risk assessment
  - → SIL (safety integrity level)
  - → definition of safety functions

- Automotive app
  - Hazard analysis and risk assessment acc. ISO 26262 Part 3
  - → ASIL (automotive safety integrity level)
  - → Definition of safety goals

Comparison shows, that different requirements result out of the standards (e.g. on SW-, HW-Level …)

COMPARISION FUNCTIONAL SAFETY REQUIREMENTS

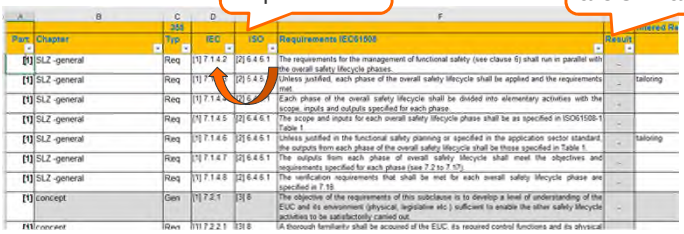
- The selected standards for functional safety include different requirements on System-, HW-, and SW-Level
- A comparison is necessary and carried out to find out the differences in detail
- Assumptions:
  - 2nd use in a stationary app
  - system is 1st used in an automotive environment
  - System fulfills the requirements of ISO 26262
  - Perspective of comparison ISO 26262 → IEC 61508
- Result of comparison shows that 100 requirements are similar

RESULT OF COMPARISION

overlapping requirements

~ 100 requirements are similar.

~ 260 requirements are not similar.



Part	Chapter	Typ	IEC	ISO	Requirements IEC61508	Result
[1]	SLZ -general	Req	[1] 7.1.4.2	[2] 6.4.5.1	The requirements for the management of functional safety (see clause 6) shall run in parallel with the overall safety lifecycle phases.	-
[1]	SLZ -general	Req	[1] 7.1.4.3	[2] 5.4.5	Unless justified, each phase of the overall safety lifecycle shall be applied and the requirements met	- tailoring
[1]	SLZ -general	Req	[1] 7.1.4.4	[2] 6.4.5.1	Each phase of the overall safety lifecycle shall be divided into elementary activities with the scope, inputs and outputs specified for each phase.	-
[1]	SLZ -general	Req	[1] 7.1.4.5	[2] 6.4.6.1	The scope and inputs for each overall safety lifecycle phase shall be as specified in ISO61508-1 Table 1.	-
[1]	SLZ -general	Req	[1] 7.1.4.6	[2] 6.4.6.1	Unless justified in the functional safety planning or specified in the application sector standard, the outputs from each phase of the overall safety lifecycle shall be those specified in Table 1.	- tailoring
[1]	SLZ -general	Req	[1] 7.1.4.7	[2] 6.4.6.1	The outputs from each phase of overall safety lifecycle shall meet the objectives and requirements specified for each phase (see 7.2 to 7.17).	-
[1]	SLZ -general	Req	[1] 7.1.4.8	[2] 6.4.6.1	The verification requirements that shall be met for each overall safety lifecycle phase are specified in 7.18	-
[1]	concept	Gen	[1] 7.2.1	[3] 8	The objective of the requirements of this subclause is to develop a level of understanding of the EUC and its environment (physical, legislative etc.) sufficient to enable the other safety lifecycle activities to be satisfactorily carried out.	-
[1]	concept	Req	[1] 7.2.2.1	[3] 8	A thorough familiarity shall be acquired of the EUC, its required control functions and its physical	

Part	Chapter	Typ	IEC	ISO	Requirements IEC61508	Result
[1]	Overall installation and commissioning planning	Gen	[1] 7.9.1.2		7.9.1.2 The second objective of the requirements of this subclause is to develop a plan for the commissioning of the E/E/PE safety-related systems in a controlled manner, to ensure the required functional safety is achieved.	-
[1]	Overall installation and commissioning planning	Req	[1] 7.9.2.1		A plan for the installation of the E/E/PE safety-related systems shall be developed, specifying: — the installation schedule; — those responsible for different parts of the installation; — the procedures for the installation; — the sequence in which the various elements are integrated; — the criteria for declaring all or parts of the E/E/PE safety-related systems ready for installation and for declaring installation activities complete; — procedures for the resolution of failures and incompatibilities.	0
[1]	Overall installation and commissioning planning	Req	[1] 7.9.2.2		A plan for the commissioning of the E/E/PE safety-related systems shall be developed, specifying: — the commissioning schedule; — those responsible for different parts of the commissioning; — the procedures for the commissioning; — the relationships to the different steps in the installation; — the relationships to the validation.	0
[1]	Overall installation and commissioning planning	Req	[1] 7.9.2.3		The overall installation and commissioning planning shall be documented.	0

NEXT STEPS

- Next steps in the project MiBZ are:
  - Detailing the differences of requirements
    - HW metrics
    - HW/ SW diagnostic measures
    - Type of faults on HW-, SW-level
  - Statement how to handle specific HW- and SW requirements
  - Break down of requirement from system level

Part	Chapter	Typ	IEC	ISO	Requirements IEC61508	Result
[2]	E/E/PE system design and development	Req	[2] 7.4.4.3.4		**Hardware safety integrity architectural constraints: Route 2** All Type B elements used in Route 2H shall have, as a minimum, a diagnostic coverage of not less than 60%.	0
[2]	E/E/PE system design and development	Req	[2] 7.4.5.1		**Requirements for quantifying the effect of random hardware failures** For each safety function, the achieved safety integrity of the E/E/PE safety-related system due to random hardware failures (including soft-errors) and random failures of data communication processes shall be estimated in accordance with 7.4.5.2 and 7.4.11, and shall be equal to or less than the target failure measure as specified in the E/E/PE system safety requirements specification (see IEC 61508-1, 7.10).	0

MANY THANKS

- Thank you very much for your attention
- German Ministry of Education, Science, Research and Technology (BMBF), for financial funding the project (Förderkennzeichen 03XP0027G)
- BEVS for the invitation and the chance to show the results

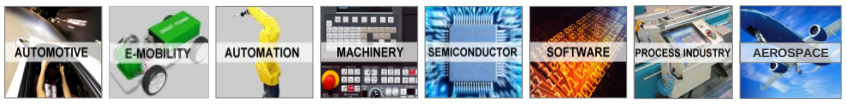
SGS - SOCIÉTÉ GÉNÉRALE DE SURVEILLANCE

- Founded: 1878 in Rouen – France
- Head quarters: Geneva
- World leading testing organization with more than 95.000 employees
- Global network more than 2.000 locations und laboratories in more than140 countries

SGS LOCATIONS GERMANY

- Functional Safety
- Homologation
- Battery Test House
- EMC

SERVICES SGS-TÜV SAAR FUNCTIONAL SAFETY



Training Personal qualification	Consulting	Safety analysis	Assessment Certification



CONTACT

SGS-TÜV Saar GmbH
E-Mobility/ Functional Safety
Michael Vogt
Hofmannstraße 50
81379 München, Germany
t +49 89 787475 - 273
f +49 89 787475 - 217
michael.vogt@sgs.com

WWW.SGS.COM
WWW.SGSGROUP.DE
WWW.SGS-TUEV-SAAR.COM

WHEN YOU NEED TO BE SURE