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Model-based Analysis & Engineering of Novel Architectures for Dependable Electric Vehicles

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2.9	2014-01-31	Final draft for review
3.0	2014-02-18	Final release

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Henrik Lönn	2014-02-18

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1 Introduction

This document contains the requirements, needs and use cases collected for the project.

Requirements are assigned to work packages. There is one chapter per work package, summing up all requirements relevant for the corresponding WP. Use Cases and engineering scenarios are collected in a separate chapter “Engineering Scenarios”.

Throughout the project a requirement will go through the states “Proposed”, “Approved”, “Addressed” or “Rejected”, as shown in Figure 1.

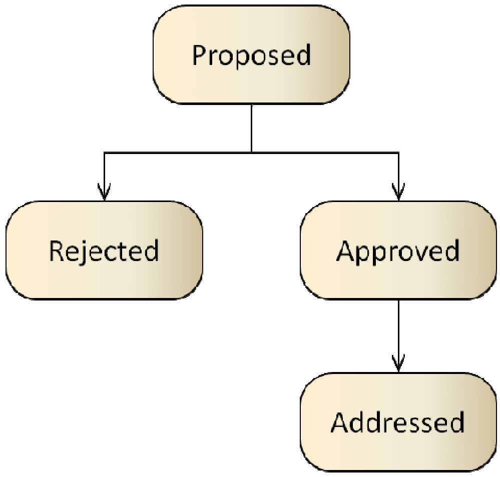


Figure 1: Lifecycle of a requirement

Requirements are derived from the project challenges and project objectives, which are defined in the Description of Work, and listed in Section “General - High Level Requirements”. Furthermore, requirements and use cases are grouped thematically, e.g. all requirements related to safety standards have an according relationship as shown the figures and in the “Relations” row of the tables.

In total, 382 requirements (incl. high level requirements) and use cases have been collected for the project. Finally 368 of them were addressed and 14 were rejected. Final over all status and priorities can be seen in Figure 2 and Figure 3.

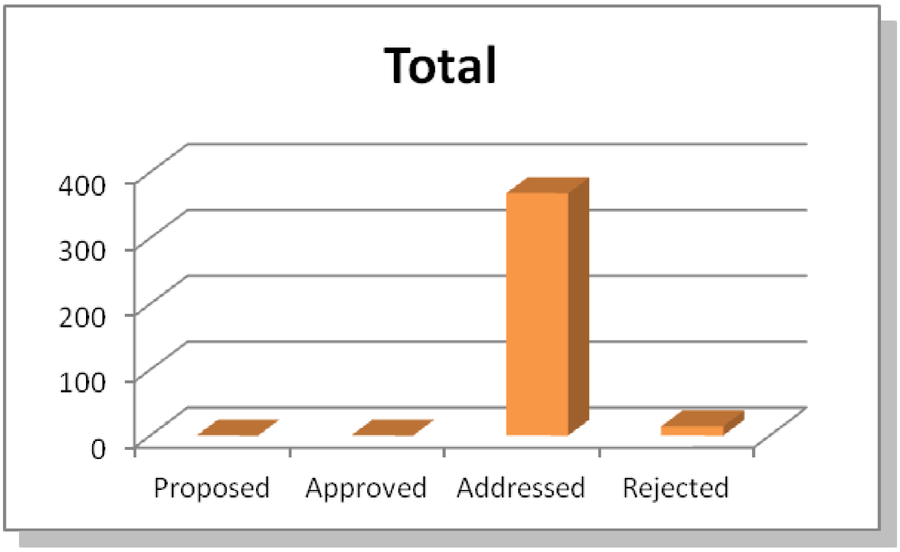


Figure 2: Status of requirements

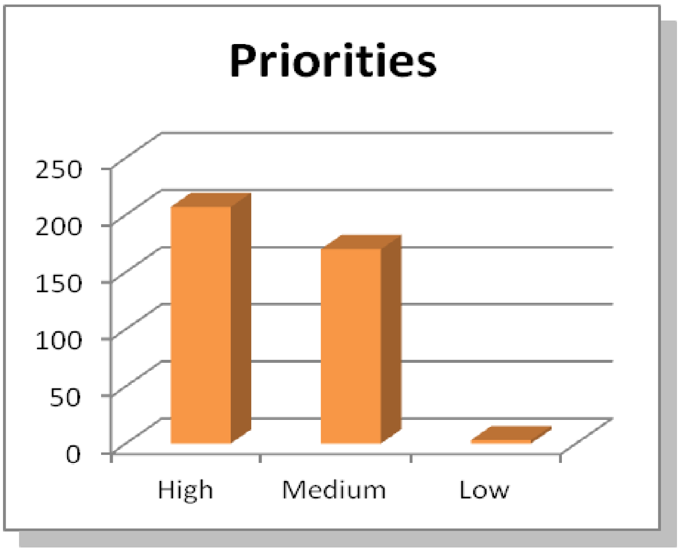


Figure 3: Priorities of requirements

2 Needs and Requirements: Overall Concept

The requirements are the result of the analysis of several needs. These needs are derived from the general project objectives (O1…O4), and especially refer to the application of ISO 26262 and to electric vehicles. The needs are classified as follows (see also Figure 4):

- Engineering roles
- Engineering phases
- Engineering topics
- Engineering methods

Requirements address one or more needs, as to justify their definition with respect to the needs.

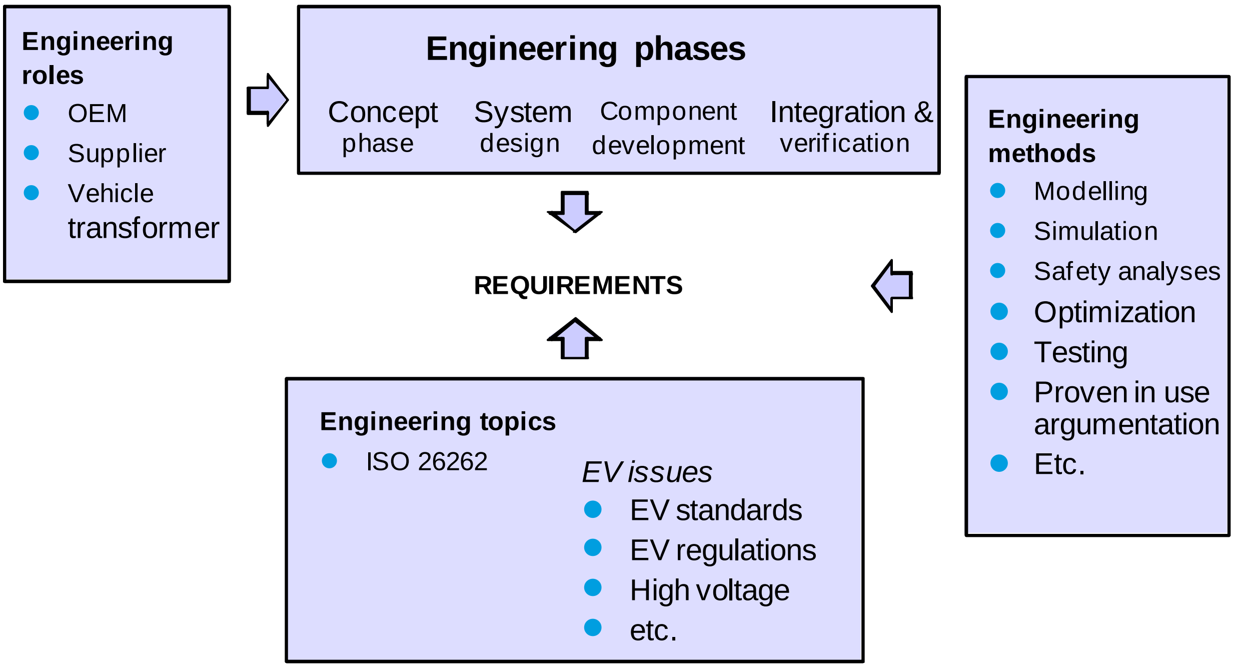


Figure 4: Classification of needs

The needs expressed to MAENAD represent the interest of the different stakeholders involved in the development of E/E automotive systems for electric vehicle applications, taking into account the introduction of ISO 26262 in the engineering process.

The main stakeholders identified are the end users, divided in three categories: OEMs, component suppliers, and vehicle transformers.

Different needs for each of them have been identified:

<u>OEMs</u>

To manage joint development with suppliers (w.r.t. ISO 262622 DIA – Development Interface Agreement)

To introduce unconventional technologies (e.g. power electronics, lithium batteries, propulsion motors…)

To apply (unusual) standards and regulations (required for EVs)

To master and manage safety, durability, performance issues, according to ISO 26262 and EV applications

Component suppliers

To be able to extend analyses and verification to vehicle level (w.r.t. risk assessment)

To introduce assumption approach to enable the development of safety qualified products, according to the approach recommended by ISO 26262 concerning the generic elements, also called SEooC (Safety Elements out of Context)

To minimize the impact of custom requirements (qualification issues w.r.t. Parts 5 and 6 ISO 26262)

Vehicle transformers

They usually are SMEs who adapt series production cars to install traction systems. Their concern is:

To assure EV safety in a context of possible confidentiality barriers

To avoid big investments in knowledge and tools.

As the engineering phases are concerned, whilst the end users are interested in the whole product lifecycle, only the concept and system development phases are in the main focus of MAENAD. However, some subsequent phases should be also addressed, such as component development, testing, validation, and safety assessment, because these phases are directly linked to the previous ones and many requirements related to the design phase take into account the subsequent activities.

In general, all the good practices adopted in engineering shall be supported in MAENAD. During the above phases, some engineering methods have been considered to categorize the requirements at high level:

Model based engineering

Simulation

Safety analysis methods (FMEA, FTA, Markov, RBD, etc.)

Optimization techniques

Test methods and related issues (fault injection, test coverage, etc.)

Proven in use argumentation

Concurrent engineering

The project should especially address the needs of the engineers involved in the development of electric vehicles. Several engineering topics related to these applications have been identified, for which it is necessary:

To be supported in the application of ISO 26262

To be supported in the application of EV standards (that lay inside address the perimeter of MAENAD)

To be supported in the application of EV regulations (that lay inside address the perimeter of MAENAD)

To assure that the risks coming from high voltage are properly managed (e.g. insulation requirements, monitoring, recovery)

To include energy management as a key function to cover in the development with suitable tools (if required)

To include braking as function to cover due to system impact (integration of hydraulic and electric, HMI, energy management, safety architecture, etc.)

To include charging as a function to cover due to system impact (grounding, communication, vehicle operation)

To include integration with auxiliaries as an engineering topic due to different impacts (design information requirements, safety, assumptions, etc.)

To analyze the possible failures introduced by new technical solutions (PM motors, lithium, etc.)

To consider the variability of propulsion systems and related equipment (wheel motors, motor technologies, on board/off board charging, etc.)

According to the above needs, a series of high level requirements have been identified, as a preliminary guide to derive more detailed requirements, directly related to the WP objectives.

The list of the high level requirements is reported in the following tables, which also highlight the relationship between them and the needs, in terms of main purpose of requirements (xxx) or relevance to the needs (x).

	User level requirements	EV-specific issues requirements							EV safety standards											
4SG#		27	29	30	31	32	33	34	7	8	9	10	11	12	13	14	15	16	17	18
	Needs (w.r.t. EVs, ISO 26262 and Maenad goals)	EV-specific issues/ High voltage	EV-specific issues/ Energy management	EV-specific issues/ Braking	EV-specific issues/ Charging	EV-specific issues/ Parking	EV-specific issues/ Integration with auxiliares	EV-specific issues/ EV-technology related failures	EV safety standards/ ISO 6469-1	EV safety standards/ ISO 6469-2	EV safety standards/ ISO 6469-3	EV safety standards/ EN 1987-1	EV safety standards/ EN 1987-2	EV safety standards/ EN 1987-3	EV safety standards/ J2344	EV safety standards/ UL 2231-1	EV safety standards/ UL 2231-2	EV safety standards/ EN 61851-21	EV safety standards/ J1766	EV safety standards/ J2289
Engineering roles	**To take into account the user's needs according to their specific business roles**																			
OEM	To manage joint development with suppliers (w.r.t. ISO 262622 DIA)	X		X	X	X	X													
	To introduce unconventional technologies (e.g. power electronics, lithium batteries, propulsion motors…)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		X	X
	To apply (unusual) standards and regulations				X				X	X	X	X	X	X	X	X	X	X	X	X
	To master and manage safety, durability, performance issues	X	X	X	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X
Supplier	To extend analyses and verification to vehicle level (w.r.t. Risk assessment)			X	X	X	X			X			X		X	X	X			
	To introduce assumption approach to enable the development of safety qualified products			X	X	X	X													
	To minimize the impact of custom requirements (qualification issues w.r.t. Parts 5 and 6 ISO 26262)				X	X	X													
Vehicle transformers	To assure EV safety in a context of possible confidentiality barriers			X		X	X													
	To avoid big investments in knowledge and tools (SMEs)																			
Engineering technical topics	**To address ISO 26262 and EV topics**																			
ISO 26262	To be supported in the application of ISO 26262																			
EV standards	To be supported in the application ov EV standards (that lay inside address the perimeter of Maenad)	X			X				XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX
EV regulations	To be supported in the application ov EV regulations (that lay inside address the perimeter of Maenad)	X		X	X															
High voltage	To assure that the risks coming from high voltage are properly managed (e.g. insulation req.s, monitoring, recovery)	XXX			X				X		X	X		X	X	X	X	X		
Energy management	To include energy management as a key function to cover in the development with suitable tools (if required)		XXX		X															
Braking	To include braking as function to cover due to system impact (integration of hydraulic and electric, HMI, energy management, safety architecture, etc.)		X	XXX		XXX									X					
Charging	To include charging as a function to cover due to system impact (grounding, communication, vehicle operation)	X			XXX	X	X		X			X				X	X	X		
Integration with auxiliares	To include integration with auxiliares as a engineering topic due to different impacts (design information requirements, safety, assumptions, etc.)		X	X			XXX													
EV-technology related failures	To analyse the possible failures introduced by new technical solutions (PM motors, lithium, etc.)				X			XXX	X	X		X	X		X					
Variability of electrical architectures	To consider the variability of propulsion systems and related equipment (wheel motors, motor technologies, on board/off board charging, etc.)	X		X	X			X												
Engineering phases	**To cover the various engineering phases, according to concurrent engineering principles and ISO 26262 requirements (e.g. define verification plan during design phase)**																			
	Concept design		X	X	X	X	X	X		X			X							
	System design	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Component development	X			X	X	X	X	X		X	X		X	X					
	Integration and verification	X	X	X	X	X	X	X	X		X	X		X	X	X	X	X	X	X
Engineering methods	**To adopt the best engineering practices**																			
	Model base engineering		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Simulation		X	X				X												
	Safety analysis methods (FMEA, FTA, Markov, RBD, etc.)	X		X	X	X	X	X	X	X		X	X			X	X	X		
	Optimization techniques		X																	
	Test methods and related issues (fault injection, test coverage, etc.)	X		X	X	X	X	X	X	X	X	X	X	X	X	X	X	X		
	Proven in use argumentation							X												
	Concurrent engineering																			

Table 1 – High level user requirements and their relevance to user needs (part 1)

	User level requirements	EV performance standards					EV communication std.s			ISO 26262						
4SG#		19	20	21	22	23	24	25	26	40	46	47	48	49	50	51
	Needs (w.r.t. EVs, ISO 26262 and Maenad goals)	EV performance standards/ ISO 8715	EV performance standards/ ISO 8714	EV performance standards/ EN 1821-1	EV performance standards/ EN 1986-1	EV performance standards/ ISO 12405-2	EV communication standards/ ISO 15118	EV communication standards/ J2836	EV communication standards/ J2847	ISO 26262-3/ Hazard analysis and risk assessment	ISO 26262-9/ ASIL decomposition	ISO 26262-4/ System Design	ISO 26262-4/ Verification of the safety requirements	ISO 26262-4/ Test methods	ISO 26262-4/ Modelling for safety analises	ISO 26262-4/ Description of failure rate metrics
Engineering roles	**To take into account the user's needs according to their specific business roles**															
OEM	To manage joint development with suppliers (w.r.t. ISO 262622 DIA)									X	X	X	X	X	X	X
	To introduce unconventional technologies (e.g. power electronics, lithium batteries, propulsion motors...)	X	X	X	X	X	X	X	X							
	To apply (unusual) standards and regulations	X	X	X	X	X	X	X	X							
	To master and manage safety, durability, performance issues	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Supplier	To extend analyses and verification to vehicle level (w.r.t. Risk assessment)						X	X	X	X	X	X	X	X	X	X
	To introduce assumption approach to enable the development of safety qualified products						X	X	X	X	X	X	X		X	X
	To minimize the impact of custom requirements (qualification issues w.r.t. Parts 5 and 6 ISO 26262)															
Vehicle transformers	To assure EV safety in a context of possible confidentiality barriers									X	X	X	X	X	X	X
	To avoid big investments in knowledge and tools (SMEs)															
Engineering technical topics	**To address ISO 26262 and EV topics**															
ISO 26262	To be supported in the application of ISO 26262									XXX	XXX	XXX	XXX	XXX	XXX	XXX
EV standards	To be supported in the application ov EV standards (that lay inside address the perimeter of Maenad)	XXX	XXX	XXX	XXX	XXX	XXX	XXX	XXX							
EV regulations	To be supported in the application ov EV regulations (that lay inside address the perimeter of Maenad)															
High voltage	To assure that the risks coming from high voltage are properly managed (e.g. insulation req.s, monitoring, recovery)						X	X	X							
Energy management	To include energy management as a key function to cover in the development with suitable tools (if required)	X	X	X	X	X	X	X	X							
Braking	To include braking as function to cover due to system impact (integration of hydraulic and electric, HMI, energy management, safety architecture, etc.)															
Charging	To include charging as a function to cover due to system impact (grounding, communication, vehicle operation)						X	X	X							
Integration with auxiliares	To include integration with auxiliares as a engineering topic due to different impacts (design information requirements, safety, assumptions, etc.)															
EV-technology related failures	To analyse the possible failures introduced by new technical solutions (PM motors, lithium, etc.)									X	X	X				
Variability of electrical architectures	To consider the variability of propulsion systems and related equipment (wheel motors, motor technologies, on board/off board charging, etc.)						X	X	X							
Engineering phases	**To cover the various engineering phases, according to concurrent engineering principles and ISO 26262 requirements (e.g. define verification plan during design phase)**															
	Concept design	X	X	X	X	X				X	X		X			
	System design	X	X	X	X	X						X	X	X	X	X
	Component development															
	Integration and verification													X		
Engineering methods	**To adopt the best engineering practices**															
	Model base engineering	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	Simulation	X	X	X	X	X	X	X	X	X	X	X	X	X		
	Safety analysis methods (FMEA, FTA, Markov, RBD, etc.)						X	X	X	X	X	X			X	X
	Optimization techniques	X	X	X	X	X										
	Test methods and related issues (fault injection, test coverage, etc.)						X	X	X					X		
	Proven in use argumentation															
	Concurrent engineering															

Table 2 – High level user requirements and their relevance to user needs (part 2)

3 Analysis of EV specific standards and regulations

Specific standards and regulations with impact on FEV development have been analyzed, and requirements on the EAST-ADL as well as on the methodology were derived. The overall procedure is shown in Figure 5.

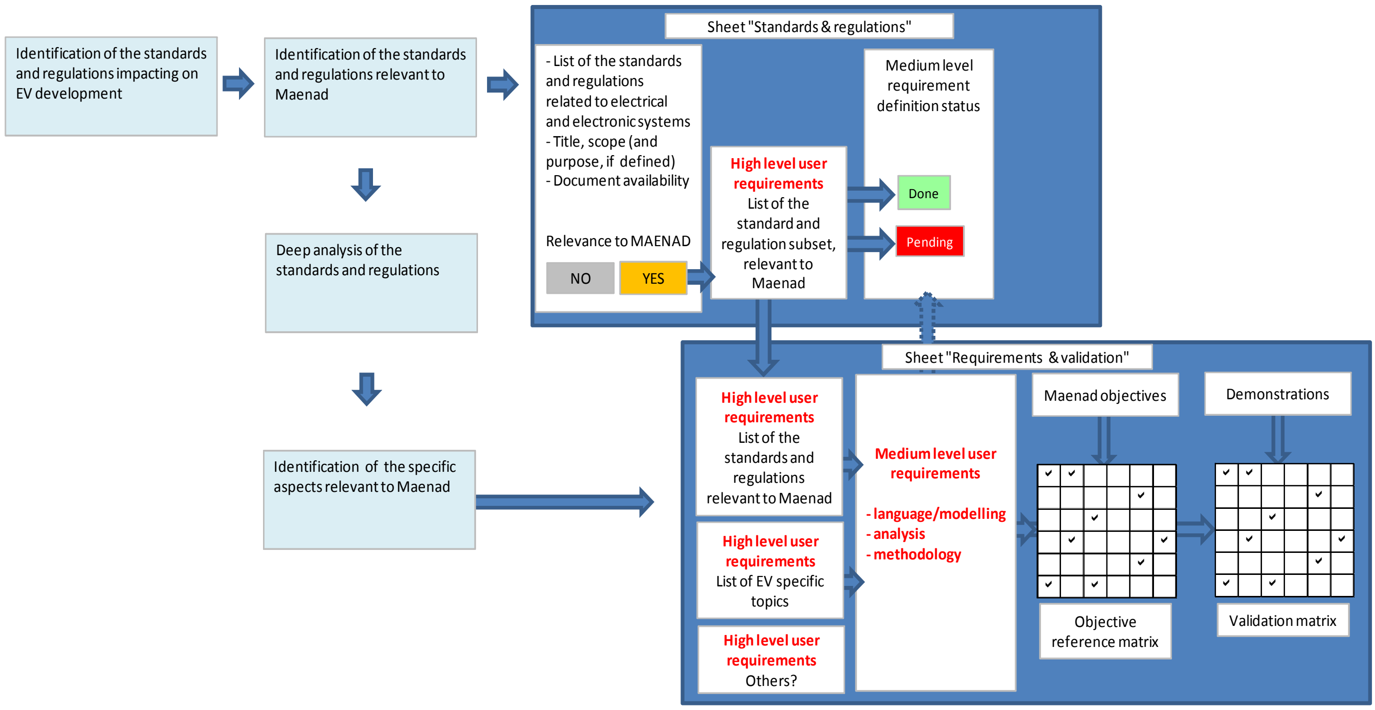


Figure 5: Process to define and trace requirements derived from EV standards

The process followed to specify the requirements for MAENAD was based on the following steps:

A. The identification of the standards and regulations that can impact on the development on EVs. The analysis included not only the present ones, but also some of the proposed ones, which are the subject of ongoing activities of working groups.

B. A preliminary analysis of the standard and regulations was performed, to evaluate the relevance to MAENAD objectives. As a consequence, a subset of the previous list was defined and a list of high level requirements was compiled. Table 3 and Table 4 collect the above information, and also the status of the analysis progress.

C. The subsequent step was a deep analysis of the standards and regulations included in the previous list. The purpose of this analysis was to identify the requirements contained in each standard and regulation, relevant to MAENAD. The relevance was considered in those cases in which any design activity involve E/E systems, especially in terms of functions, electric characteristics, performance, safety, communication, design methods, test requirements, etc. On the contrary, mechanics, environmental conditions, EMC, and operational procedures not related to the design phase have been excluded. The tables included in the paragraph “Detailed analysis report of EV specific standards and regulations” of this deliverable report the results of analysis performed.

D. The requirements excerpted from the previous steps were analyzed to identify the requirements classified in three categories: language/modeling, analysis, and methodology, addressing, respectively, EAST-ADL and system modeling especially at system level, analysis activities necessary to complement the design process, and, in general, any design or verification activity necessary to cover the development of EV E/E systems, especially in relation with the EV specific engineering topics.

E. The requirements identified in the preceding step were reported in a summary table, an id-code was assigned to trace them. The requirements are available to be included in the overall list realized using Enterprise Architect.

F. In order to check the consistency of the requirements with MAENAD objectives and the complete coverage of them with at least one requirement, a matrix was compiled.

G. At the same way a matrix was set up to verify that the requirements will be properly validated in the demonstration WP (WP6), according to the concept proposed in one of the next paragraphs ("Requirement validation"). This matrix (see Table 11) is preliminary and is intended to give recommendations to WP6, to validate MAENAD results against MAENAD requirements.

EV standards and regulations					High level user requirement		Medium level user requirement status	Note
Id.	**Title**	**Scope** (the text may be more extensive than shown in the box)	**Availability**	**Relevance to Maenad**	**id.**	**Title**		
ISO 6469-1 (EN 1987-1)	Electric road vehicles — Safety specifications — Part 1: On-board electrical energy storage	This part of ISO 6469 specifies requirements for the on-board electrochemical storage of energy for the propulsion of exclusively battery-powered electric road vehicles (passenger cars and light commercial vehicles) for the purpose of protecting persons and the	YES	YES	4SG 7	EV safety standards/ ISO 6469-1	Done	
ISO 6469-2 (EN 1987-2)	Electric road vehicles — Safety specifications — Part 2: Functional safety means and protection	This part of ISO 6469 specifies requirements for functional safety means and protection against failures related to the specific hazard of the electrical propulsion of exclusively battery powered electric road vehicles (passenger cars and light commercial vehicles).	YES	YES	4SG 8	EV safety standards/ ISO 6469-2	Done	
ISO 6469-3 (EN 1987-3)	Electric road vehicles — Safety specifications — Part 3: Protection of persons against electric hazards	This part of ISO 6469 specifies requirements for the protection of persons against electrical hazards on exclusively battery-powered electric road vehicles (passenger cars and light commercial vehicles) when the vehicles are not connected to an external power supply.	YES	YES	4SG 9	EV safety standards/ ISO 6469-3	Done	
SAE J2344	Guidelines for Electric Vehicle Safety	This SAE Information Report identifies the preferred technical guidelines relating to safety for vehicles that contain High Voltage (HV) during normal operation and charging, as applicable.	YES	YES	4SG 13	EV safety standards/ J2344	Done	
UL2231-1	Standard for Safety Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits:	These requirements cover devices and systems intended for use in accordance with the National Electrical Code (NEC), ANSI/NFPA 70, Article 625, to reduce the risk of electric shock to the user from accessible parts, in grounded or isolated circuits for charging electric	No	YES	4SG 14	EV safety standards/ UL 2231-1	Pending	
UL2231-2	Standard for Safety Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits:	This standard is intended to be read together with the Standard for Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: General Requirements, UL 2231-1. The requirements of UL 2231-1 apply unless modified by this standard.	No	YES	4SG 15	EV safety standards/ UL 2231-2	Pending	
CEI EN 61851-1	Electric vehicle conductive charging system Part 1: General requirements	This part of IEC 61851 applies to equipment for charging electric road vehicles at standard a.c. supply voltages (as per IEC 60038) up to 690 V and at d.c. voltages up to 1000 V, and for providing electrical power for any additional services on the vehicle if required when connected to	YES	YES			Done	
CEI EN 61851-21	Electric vehicle conductive charging system Part 21: Electric vehicle requirements for conductive	This part of IEC 61851 together with part 1 gives the electric vehicle requirements for conductive connection to an a.c. or d.c. supply, for a.c. voltages according to IEC 60038 up to 690 V and for d.c. voltages up to 1000 V, when the electric vehicle is connected to the supply network.	YES	YES	4SG 16	EV safety standards/ EN 61851-21	Done	
CEI EN 61851-22	Electric vehicle conductive charging system Part 22: AC electric vehicle charging station	This part of IEC 61851, together with part 1, gives the requirements for electric vehicle charging stations for conductive connection to an electric vehicle, with a.c. supply voltages according to IEC 60038 up to 690 V.	YES	NO		N.A.	N.A.	This part of IEC 61851 addresses the stationary charging equipment.
SAE J1766	Recommended practice for electric and hybrid electric vehicle battery system crash integrity testing	Electric and Hybrid Vehicles contain many types of battery systems. Adequate barriers between occupants and battery systems are necessary to provide protection from potentially harmful factors and materials within the battery system that can cause injury to occupants	YES	NO	4SG 17	EV safety standards/ J1766 (to be cancelled)	N.A.	The electrical aspects addressed by this standard are limited to insulation requirements after crash. The insulation aspects relevant to Maenad purpose are covered by other standards
SAE J2289	Electric Driver Battery Pack System Functional Guidelines	The mission of this document is to provide guidance in designing vehicle level battery systems for Electric Vehicles and Hybrid Electric Vehicles using electrically rechargeable battery modules. Items addressed include battery system content, component and system	Y (2000)	YES	4SG 18	EV safety standards/ J2289	Done	
ISO 8714	Electric road vehicles — Reference energy consumption and range — Test procedures for	This International Standard specifies test procedures for measuring the reference energy consumption and reference range of purely electrically propelled passenger cars and commercial vehicles of a maximum authorized total mass (in accordance with ISO 1176) of 3 500	YES	YES	4SG 20	EV performance standards/ ISO 8714	Done	
ISO 8715	Electric road vehicles — Road operating characteristics	This International Standard specifies the procedures for measuring the road performance of purely electrically propelled passenger cars and commercial vehicles of a maximum authorized total mass of 3 500 kg1 . The road performance comprises road operating characteristics such as	YES	YES	4SG 19	EV performance standards/ ISO 8715	Done	
EN 1821-1	Electrically propelled road vehicles - Measurement of road operating ability - Part 1: Pure electric vehicles	This Standard specifies the principles, conditions and procedures of the test methods to measure the road performances of electrically propelled road vehicles (pure electric vehicles).	No	YES	4SG 21	EV performance standards/ EN 1821-1	Pending	
EN 1986-1	Electrically propelled road vehicles - Measurement of energy performances - Part 1: Pure electric vehicles	This Standard specifies the procedure to apply in order to measure the range and the consumption of the electrically propelled road vehicles (pure electric vehicles). This standard applies to the categories of vehicles M1, M2, N1 and N2 motor tricycles and quadricycles from the	No	YES	4SG 22	EV performance standards/ EN 1986-1	Pending	
ISO 12405-1	Electrically propelled road vehicles — Test specification for lithium-ion traction battery packs and	This Standard specifies test procedures for lithium-ion battery packs and systems, to be used in electrically propelled road vehicles. The specified test procedures enable the user of this standard to determine the essential characteristics on performance, reliability and	YES	NO		N.A.	N.A.	This standard is generally applicable to EHV and FCV.
ISO 12405-2	Electrically propelled road vehicles — Test specification for lithium-ion traction battery packs and	This Standard specifies test procedures for lithium-ion battery packs and systems, to be used in electrically propelled road vehicles. The specified test procedures enable the user of this standard to determine the essential characteristics on performance, reliability and	No	YES	4SG 23	EV performance standards/ ISO 12405-2	Pending	This standard requires the appoval of the electrical safety design according to ISO 6469-1 and ISO 6469-3
ISO 15118 ISO 15118-1 ISO 15118-2 ISO 15118-4	Road vehicles – Communication protocol between electric vehicles and grid	Part 1: Definitions and use-cases Part 2: Sequence diagrams and communication layers Part 3: PLC Technology and Timings	No (DIS stage)	YES	4SG 24	EV communication standards/ ISO 15118	Pending	
J2836			No	YES	4SG 25	EV communication standards/ J2836	Pending	
J2847			No	YES	4SG 26	EV communication standards/ J2847	Pending	
R10	Uniform provisions concerning the approval of vehicles with regard to electromagnetic	This Regulation applies to: 1.1. vehicles of categories L, M, N and O 1/ with regard to electromagnetic compatibility; 1.2. components and separate technical units intended to be fitted in	YES	NO		N.A.	N.A.	Amendment in progress to include test requirements for EV

Table 3 – Identification of EV standards and regulations and their relevance to MAENAD (part 1)

EV standards and regulations					High level user requirement		Medium level user requirement status	Note
Id.	Title	Scope (the text may be more extensive than shown in the box)	Availability	Relevance to Maenad	id.	Title		
R12	Uniform provisions concerning the approval of vehicles with regard to the protection of the driver	This Regulation applies to the behaviour of the steering mechanism of motor vehicles of category M1, and vehicles of category N1, with a maximum permissible mass less than 1,500 kg, with regard to the protection of the driver in a frontal collision.	YES	NO		N.A.	N.A.	It applies to the behaviour of the steering mechanism of motor vehicles of category M1 and N1, with a maximum permissible mass less than 1500 kg, with regard to the protection of the driver in a frontal collision.
R12 Amendment proposal			No	YES		TBD	Pending	
R13h	Uniform provisions concerning the approval of vehicles of categories M, N and O with regard to	This Regulation applies to vehicles of categories M 2 , M 3 , N and O with regard to braking	YES	YES	4SG 70	R 13H Braking	Done	This regulation defines specifications for braking systems, taking into account two types of electric regenerative braking: • "Category A" regenerative braking which is not part of the
R18	Uniform provisions concerning the approval of motor vehicles with regard to their protection against	This Regulation applies to motor vehicles having at least three wheels with the exception of those of category M1 and N1 , with regard to their protection against unauthorized use.	YES	NO	N.A.	N.A.	N.A.	Not applicable to M1 category.
R51	Uniform provisions concerning the approval of motor vehicles having at least four wheels with	This Regulation contains provisions relating to the noise emitted by motor vehicles having at least four wheels.	YES	NO	N.A.	N.A.	N.A.	This regulation contains a measurement methodology for noise emitted by motor vehicles having at least four wheels. The following statements concerning electric vehicles can be made:
R68	Uniform provisions concerning the approval of power-driven vehicles including pure electric	This Regulation applies to the approval of power-driven vehicles including pure electric vehicles of categories M1 and N1 1/ with regard to the measurement of the maximum speed indicated by the manufacturer	YES	YES		N.A. (see note and EN 1821)	N.A.	It applies to the approval of power driven-vehicles including pure electric vehicles of categories M1 and N1 with regard to the measurement of the maximum speed indicated by the manufacturer.
R85	Uniform provisions concerning the approval of internal combustion engines or electric drive trains	This Regulation applies to the representation of the curve as a function of engine or motor speed of the power at full load indicated by the manufacturer for internal combustion engines or electric drive trains and the maximum 30 minutes power of electric drive trains intended	YES	YES		N.A. (see note)	N.A.	It applies "to the representation of the curve as a function of engine or motor speed of the power at full load indicated by the manufacturer for internal combustion engines or electric drive trains and the maximum 30 minutes power of electric
R89	Uniform prescriptions for approval of: I. Vehicles with regard to limitation of their maximum	This Regulation applies to: 1.1.1. Part I: Vehicles of categories (1) M3, N2 and N3 (2) equipped with an SLD and to vehicles of categories M and N equipped with an adjustable speed limitation device ASLD which have not been	YES	NO	N.A.	N.A.	N.A.	Non applicable to M1 category.
R94 Amendment proposal	Proposal for 02 series of amendments to Regulation No. 94 (Uniform provisions concerning the approval of	Extension to alla king of powertrain. This Regulation applies to vehicles of category M1 of a total permissible mass not exceeding 2.5 tonnes; other vehicles may be approved at the request of the manufacturer.	YES	YES	CRF# 0002	R94 new EV proposals Front collision	Pending	
R100	Uniform provisions concerning the approval of battery electric vehicles with regard to specific		YES	YES	N.A.	N.A. (see note, EN 1987 and ISO 6469)	N.A.	It applies to safety requirements with respect to all battery-electric road vehicles of categories M and N, with a maximum design speed exceeding 25 km/h. This document, in terms of its structure and contents, is comparable to the
R101	Uniform provisions concerning the approval of passenger cars equipped with an internal combustion		YES	YES	N.A.	N.A. (see note, EN 1986-1)	N.A.	This Regulation applies to the measurement of the emission of carbon dioxide (CO2) and fuel consumption for M1 category vehicles, or to the measurement of electric energy consumption and range of categories M1 and N1 vehicles.
R116	Uniform technical prescriptions concerning the protection of motor vehicles against unauthorized use	This Regulation applies to: 1.1. PART I - Approval of a vehicle of category M1 and N1 with regard to its devices to prevent unauthorized use. 1.2. PART II - Approval of vehicle alarm systems (VAS) which are	YES	YES	4SG 75	R 116 Unauthorized use	Done	See also FMVSS No. 114 - Theft protection
R121	Uniform provisions concerning the approval of vehicles with regard to the location and identification	This Regulation applies to vehicles of categories M and N 1/. It specifies requirements for the location, identification, colour, and illumination of motor vehicle hand controls, tell-tales and indicators. It is designed to ensure the accessibility and visibility of vehicle controls, tell-tales,	YES	NO	N.A.	N.A.	N.A.	
R122	Uniform technical prescriptions concerning the approval of vehicles of categories m, n and o with	This regulation applies to all vehicles in categories M, N and O in which a heating system is fitted.	YES	NO	N.A.	N.A.	N.A.	No specific requirements for EV, even if EVs have specific heating components.
UL 2202	Electric Vehicle (EV) Charging System Equipment	These requirements cover conductive and inductive charging system equipment intended to be supplied by a branch circuit of 600 volts or less for recharging the storage batteries in over-the-road electric vehicles (EV). The equipment is located on- or off-board the vehicle.	YES	NO	N.A.	N.A.	N.A.	This standard addresses especially physical and electrical requirements
UL 2251	Plugs, Receptacles and Couplers for Electric Vehicles	These requirements cover plugs, receptacles, vehicle inlets, and connectors, rated up to 800 amperes and up to 600 volts ac or dc, intended for conductive connection systems, for use with electric vehicles in accordance with National Electrical Code (NEC), ANSI/NFPA-	YES	NO	N.A.	N.A.	N.A.	This standard addresses especially physical and electrical requirements
SAE J1772	SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler	Tis SAE Recommended Practice covers the general physical, electrical, functional and performance requirements to facilitate conductive charging of EV/PHEV vehicles in North America. This document defines a common EV/PHEV and supply equipment vehicle conductive charging	YES	YES	4SG 74	J1772 Conductive charge coupler	Done	Specific requirements relevant to maenad are pilot communication and charging management.
FMVSS No. 102	Transmission shift lever sequence, starter interlock, and transmission braking effect	This standard specifies the requirements for the transmission shift lever sequence, a starter interlock, and for a braking effect of automatic transmissions, to reduce the likelihood of shifting errors, starter engagement with vehicle in drive position, and to provide	YES	YES	4SG 73	FMVSS No. 114 Trasmission shift lever	Done	
FMVSS No. 105	Hydraulic and electric brake systems	This standard specifies requirements for hydraulic and electric service brake systems, and associated parking brake systems.	YES	NO	N.A.	N.A.	N.A.	Does not apply to road vehicles weighting less than 3500 kg. See instead FMVSS 135
FMVSS No. 114	Theft protection	This standard specifies requirements primarily for theft protection to reduce the incidence of crashes resulting from unauthorized operation of a motor vehicle. It also specifies requirements to reduce the incidence of crashes resulting from the rollaway of parked vehicles	YES	YES	4SG 72	FMVSS No. 114 Theft protection	Done	
Proposed FMVSS No. 126	Electronic Stability Control Systems		YES	NO	N.A.	N.A.	N.A.	No specific requirements for EV are considered in the preliminary regulatory impact analysis-
FMVSS No. 135	Passenger car brake systems	This standard specifies requirements for service brake and associated parking brake systems.	YES	YES	4SG 71	FMVSS No. 135 Passenger car brake systems	Done	
CEI EN 50272-3	Safety requirements for secondary batteries and battery installations Part 3: Traction batteries	This standard applies to secondary batteries ad battery installations used for electric vehicles, ... (omissis). The nominal voltages are limited to 1000 V a.c. and 1500 V d.c. respectively and describe the principal measures for protection against hazards generally from electricity, gas	YES	NO	N.A.	N.A.	N.A.	Most of the issues addressed in this standard are covered by other standards (e.g. insulation); other issues are related to installation and maintanance operations; other to ventilation, gas emission.

Table 4 – Identification of EV standards and regulations and their relevance to MAENAD (part 2)

4 Detailed analysis report of EV specific standards and regulations

The tables included in this paragraph report the results of the analysis performed to identify the requirements for MAENAD related to EV standards and regulations, according to Table 3 and Table 4.

SAE – J2289

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
6.1	Operational modes The vehicle may be operated in the following modes and has associated electrical modes of operation: Key on Discharge Charge including end of charge while plugged in Regeneration Key off Charge including end of charge while plugged in Parked - off charging plug Operational Storage		Defining the vehicle operational modes accordingly Justify possible discrepancies
6.1.1	Key on – Discharge The system should limit occurrence and amount of over-discharge of individual battery Devices like fusing or rapid response contactors should be considered to provide insulation for ground faults, and overcurrent protection	Modeling the power supply network including fault protection devices with their current-time characteristics Modeling auxiliary equipment including power requirements/ power profiles	Assessment of battery capability to match the vehicle demand (range, supply of auxiliary equipment) Designing means to detect and limit the overdischarge of individual cells Providing fault protection devices (fuses, fast contactors)
6.1.2	Key on – Regen Operation Refer to SAE J2344 for safety effects of regen operation. During regen operation the battery voltage should not be allowed to exceed the voltage limits of the drive electronic components or the drive motor. Profiles for regen recovery and discharge current and voltage at high states of charge	Include voltage limit data/requirements of the drive components Include recommended battery current and voltage profiles during high SoC	Assessing the compliance of the voltage with the limits during regeneration Providing design means to avoid drive component overvoltage occurrence during regeneration Verifying the compliance with current and voltage profiles Providing design means to limit battery current and voltage during regeneration according to the specified profiles
6.1.3	Key on – Charge For battery systems using external charg-	Include electrical characteristics of the charge	Verifying that all charge system components

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
	ing, individual components such as battery modules, electrical interconnects should be matched to the vehicle system charge acceptance capability.	system components (e.g. current, voltage)	match w.r.t. electrical characteristics Designing charge algorithm with the battery supplier
6.1.4.1	Key-Off Parked Off Plug Operating Energy drain should be managed to limit discharge and self discharge.	Include the power characteristics of the devices running in key-off mode (e.g. headlight usage, continued operation of: clock, anti-theft system, remote entry, cellular telephone, pre-heat or pre-cool thermal management timing and control systems)	Providing energy management to prevent excessive discharge due to vehicle equipment operating in key-off mode Verify energy behavior in key-off mode by simulation/calculation
6.1.4.2	Parked Off Plug IDLE/Storage Operation The vehicle system or operator/service technician should be able to disconnect the battery circuit when placed in this operational mode. This mode may be used while waiting for service operations or shipping as a safety consideration.	Modeling battery disconnect system	Designing a battery disconnect system for operation during storage or maintenance
6.2.2 6.2.3	TRACTION WIRING AND CONNECTORS SENSOR WIRING Separation of high voltage and low voltage wiring	Modeling of high voltage connections and devices (specific representation)	Designing wiring routing keeping separation of high voltage wires and sensors (also inside battery system)
6.2.4	CONTACTORS/DISCONNECTS Interlock mechanism that disconnects the battery circuit when the battery is disconnected from the vehicle or the battery tray is opened to allow service.	Modeling interlock mechanism to disconnect battery system	Designing an interlock mechanism to disconnect battery system
6.2.4.1	*Contactors* Contactor operation should be under the control of the vehicle electric drive control system and also may include deactivation by crash sensors or insulation fault detection to provide insulation protection in crash or insulation breakdown.		Designing contactor operation as to be deactivated in the case of crash or insulation fault
6.2.4.2	*Disconnects* Reference SAE J2344		Designing disconnect system for added safety during service or by first responders during accidents.
6.5	Electrical Insulation Electrical insulation impedance of the pack shall meet the requirements of SAE J1766		
6.6.1	DISCHARGE MANAGEMENT—PERFORMANCE LIMITS The monitoring/management system should protect for overtemperature, under-temperature, over-current/ exceeding peak power, and under-voltage operation.	Description: include the operation limits of the battery	Designing BMS to protect for overtemperature, under-temperature, over-current
6.6.2	CHARGE MANAGEMENT		Design communication

Std. ref.	**Requirement of the standard**	**Requirement to system description and modeling**	**Requirement to design methodology**
	The charge control algorithms may be contained within the battery controller and can communicate with Level I, Level II or Level III chargers as per SAE J1772, SAE J1773, and SAE J2293.		in compliance with SAE J1772, SAE J1773, and SAE J2293.
6.7.2	KEY-ON STARTUP DIAGNOSTICS AND WARNING At key-on, the battery management system should provide some level of verification that the pack can function and that there are no serious faults present. If a failure is detected, a visible warning may alert the driver possibly with different levels of warning depending on the severity of the fault.	Defining and representing different levels of warning (depending on the severity of the fault)?	Design key-on diagnostics procedures of the battery system For example, on startup, the battery management system may be able to verify that all sensors and actuators like contactors, fans, pumps are responding correctly.
6.7.3	KEY-ON RUNNING DIAGNOSTICS AND WARNING During operation, the battery management system should be able to determine the occurrence of potential faults and alert the driver.		Design key-on running diagnostics and warning procedures. For example, the system could detect system faults like fan or pump failure, as well as loss of function of sensors, and electrical fault conditions like cell failure, cell reversal, internal short circuits, and high voltage ground faults.
6.7.4	SERVICE DIAGNOSTICS		Design service diagnostics
6.7.5	MULTIPLEX COMMUNICATION INTERFACE (Protocols, routing, testing)		Design and verify communication cable routing inside battery system
7.3.1.1	*Toxic Emissions*		In the hazard analysis include toxic emissions caused by battery damages (e.g. depending on management failures)
7.3.1.2	*Flammable Gasses*		Idem

ISO 6469-1

Electrically propelled road vehicles – Specific requirements for safety

Part 1: On board energy storage

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
6.1 Insulation resistance of the RESS	The measurement of the insulation resistance of the RESS shall include auxiliary components located inside the RESS housing, e.g. monitoring or temperature-conditioning devices and liquid fluids (if any).	Insulation, insulation attributes (withstand voltage, resistance, presence of DC or AC parts, creepage distance, ref. to standards...) Insulation devices (to describe the interconnection between isolated and not isolated physical parts, e.g. communication, power supply, drives) High voltage parts (w.r.t. physical view) in order to take note of the requirements regarding creepage distance, clearance, labeling, wire color, insulation.	Deployment of insulation resistance Addressing insulation monitoring system Hazard analysis and risk assessment concerning insulation monitoring Design issues concerning recharging (grounding, communication) Test planning concerning insulation Production, operation and maintenance requirements during design phase (ISO 26262-4)
6.4	Heat generation under any first-failure condition, which could form a hazard to persons, shall be prevented by appropriate measures, e.g. based on monitoring of current, voltage or temperature.		Designing a monitoring system to prevent dangerous effects to persons, in the case of failures producing heat generation
7	RESS over-current interruption. If a RESS system is not short-circuit proof in itself, a RESS over-current interruption device shall open the RESS circuit under conditions specified by the vehicle and/or RESS manufacturer, to prevent dangerous effects for persons, the vehicle and the environment.		Designing an overcurrent interruption device Hazard analysis in the case of short circuit of RESS Planning of short circuit test

ISO 6469-2

Electric road vehicles – Safety specifications

Part 2: Vehicle operational safety means and protection against failures

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
5 5.1	Electric road vehicles - Safety specifications - Part 2: Functional safety means and protection against failures		Designing deliberate and distinctive actions for power-on, one for power-off.
5.2	5 Operational safety 5.2 Connection of the vehicle to an off-board electric power supply		Designing a means to make impossible to move the vehicle when connected to off-board electric power supply and charged by the user.
5.3.1	5 Operational safety 5.3 Driving 5.3.1 Indication of reduced power		Designing a warning to signal to the driver that the propulsion power is reduced, in the case this is done (to limit the effect of a fault or excessive power demanded by the driver).
5.3.2	5 Operational safety 5.3 Driving 5.3.2 Indication of low energy content of RESS		Designing a low state of charge warning. Defining the low state of charge level in such a way to enable vehicle movement outside traffic area and to reserve the energy for lighting.
5.4	5 Operational safety 5.4 Driving backwards		Designing means to prevent unintentional switching in reverse when the vehicle is in motion (two options are available)
5.5	5 Operational safety 5.5 Parking		Designing a warning to indicate whether propulsion is in the driving–enable mode, when user leaves the vehicle. Designing a safety mechanism to prevent unexpected movements.
6	6 Protection against failures		In functional safety development, include unintended acceleration, deceleration and reverse motion as hazards to be prevented or minimized.

ISO 6469-3

Electric road vehicles – Safety specifications

Part 3: Protection of persons against electric hazards

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
7.3	7 Measures and requirements for protection of persons against electric shock 7.3 Protection under first failure conditions		Designing mechanical and electronics means according to the standard. Verification planning for measures protection (design verification, test plan)
7.4	7 Measures and requirements for protection of persons against electric shock 7.4 Alternative approach for protection against electric shock		Conduct an appropriate hazard analysis with respect to electric shock and establish a set of measures which give sufficient protection against electric shock.
7.7.1	7 Measures and requirements for protection of persons against electric shock 7.7 Insulation resistance requirements 7.7.1 General		Assignment of insulation resistance to high voltage components as to achieve the overall insulation resistance (dc, ac cases).
7.9	7 Measures and requirements for protection of persons against electric shock 7.9 Requirements of potential equalization		Designing insulation barriers and bonded conductive equalization barriers. Planning verification of barriers, including bond testing.
7.10.1	7.10 Requirements for vehicle charging inlet 7.10.1 Voltage decrease requirement		Designing charge system, as to ensure voltage decrease of inlet according to time requirements. Verification by simulation, analysis and testing.
7.10.2	7.10 Requirements for vehicle charging inlet 7.10.2 Grounding and insulation resistance requirement for charging inlet	The physical view shall include symbols to identify chassis ground	Designing charging system as to meet insulation requirements in the case of ac and ac inlet.

R.116 and subsequent amendments

Uniform Technical Prescriptions Concerning the Protection of Motor Vehicles against Unauthorized Use

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
5.3.2 5.3.3	5.3.2. Devices to prevent unauthorized use acting on the transmission or on brakes. 5.3.3. Devices to prevent unauthorized use acting on the gearshift control		Designing devices to prevent unauthorized use (deactivation of engine in combination with a system to lock other vehicle functions, see regulation)
5.4	5.4. Electromechanical and electronic devices to prevent unauthorized use		Conduct functional safety analyses to cover the devices intended to prevents unauthorized use

Standard No. 102

Transmission shift lever sequence, starter interlock, and transmission braking effect.

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
5. S3.1.1	Location of transmission shift lever positions on passenger cars.		Designing the shift lever according to the sequence position and rotation requirements

Standard No. 105

Hydraulic and electric brake systems

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
S5.1.2.4	For an EV manufactured with a service brake system that incorporates RBS, the vehicle shall be capable of stopping from 60 mph within the corresponding distance specified in Column IV of Table II with any single failure in the RBS, and with all other systems intact. RBS: regenerative braking system. The specified distance depends on vehicle class.		This design activity regards service brakes: service braking system shall not rely on RBS contribution!
S5.3.1	An indicator lamp shall be activated when the ignition (start) switch is in the ‘‘on’’ (‘‘run’’) position and whenever any of the conditions (a) or (b), (c), (d), (e), (f), and (g) occur: (e) For a vehicle with electrically-actuated service brakes, failure of the source of electric power to the brakes, or diminution of state of charge of the batteries to less than a level specified by the manufacturer for the purpose of warning a driver of degraded brake performance (g) For an EV with RBS that is part of the service brake system, failure of the RBS.		Designing proper warning in the case of failure of brake power supply reduced SoC, RBD failure.
S5.5.2	In the event of any failure (structural or functional) in an antilock or variable proportioning brake system, the vehicle shall be capable of meeting the stopping distance requirements specified in S5.1.2 for service brake system partial failure. For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.		Verify that ABS control RBS in the case of failure of ABS
S6.2.6	Stopping distance tests at battery depleted state of charge		Analyze power management and warning of brake system supply battery, to ensure brake operation, motor shutdown and warning at battery depleted state of charge
S6.2.4	Control of RBS by ABS (if RBS is always active, also in neutral without any means to disconnect it by the driver)		Item definition: consider the RBS as part of ABS if it is always active (w.r.t. interfacing and system definition in ISO 26262)

Standard No. 114

Theft Protection

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
S4.2	Each vehicle shall have a keylocking system which, whenever the key is removed, prevents: (a) The normal activation of the vehicle’s engine or motor; and (b) Either steering or forward self mobility of the vehicle or both	Model a keylocking device with lock and unlock conditions	Design the keylocking system to prevent the activation of the motor and steering or self mobility (or both)
S4.2.1	S4.2.1 (a) Except as provided in S4.2.2 (a) and (b), the key-locking system required by S4.2 in each vehicle which has an automatic transmission with a ‘‘park’’ position shall, when tested under the procedures in S5.2, prevent removal of the key unless the transmission or transmission shift lever is locked in ‘‘park’’ or becomes locked in ‘‘park’’ as the direct result of removing the key. (b) Each vehicle shall not move more than 150 mm on a 10 percent grade when the transmission or transmission shift lever is locked in ‘‘park.’’		Design the operation of keylocking system according to the standard (see interaction with park command) Verify (by calculation and testing) that the maximum movement of the vehicle when locked is less than the max. allowable limit.
S4.2.1	(b) Notwithstanding S4.2.1, each vehicle specified therein may have a device which, when activated, permits moving the transmission shift lever from ‘‘park’’ after the removal of the key. The device shall either be operable: (1) By the key, as defined in S3; or (2) By another means, provided that steering is prevented when the key is removed from the ignition, and provided that the means for activating the device is covered by a non-transparent surface which, when installed, prevents sight of and activation of the device. The covering surface shall be removable only by use of a screwdriver or other tool.		If transmission shift lever movement is prevented by keylocking system, design a device to permit to move the lever (the means shall properly designed – see the Standard)
S4.2.2	S4.2.2 (a) Notwithstanding S4.2.1, provided that steering is prevented upon the key’s removal, each vehicle specified therein may permit key removal when electrical failure of this system (including battery discharge) occurs or may have a device which, when activated, permits key removal. The means for activating any such device shall be covered by a non-transparent surface which, when installed, prevents sight of and activation of the device. The covering surface shall be removable only by use of a screwdriver or other tool.		If steering is prevented by keylocking system, design a device to permit key removal (the means shall properly designed – see the Standard)

ISO 8715

Electric road vehicles — Road operating characteristics

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
	Terms and definitions	Apply the terms and the definitions given by the standard to define the vehicle performance characteristics (e.g. maximum speed, maximum thirty minutes speed)	
6	Test conditions	Modeling – Comply with test conditions requirements (e.g. battery state of charge, power consumption of the auxiliaries, test mass, etc.)	Simulate vehicle performance according to test conditions requirements(when applicable) Test vehicle performance according to test conditions requirements
9	Test procedures	Define test case for simulation according to the test procedures requirements	See above

ISO 8714

Electric road vehicles — Reference energy consumption and range — Test procedures for passenger cars and light commercial vehicles

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
2	Terms and definitions	Apply the terms and the definitions given by the standard to define the vehicle performance characteristics (e.g. maximum speed, maximum thirty minutes speed)	
4	Test sequence - Test conditions	Modeling – Comply with test conditions requirements (e.g. battery state of charge, power consumption of the auxiliaries, test mass, etc.)	Simulate vehicle performance according to test conditions requirements(when applicable) Test vehicle performance according to test conditions requirements
4 Annex A Annex B Annex C	Test sequence - Test procedures	Define test case for simulation according to the test procedures requirements Include standard test cycles	See above

FMVSS No. 135

Passenger car brake systems

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
S5.1.3	S5. Equipment requirements. S5.1.3 Regenerative braking system. (a) For an EV equipped with RBS, the RBS is considered to be part of the service brake system if it is automatically activated by an application of the service brake control, if there is no means provided for the driver to disconnect or otherwise deactivate it, and if it is activated in all transmission positions, including neutral. (b) For an EV that is equipped with both ABS and RBS that is part of the service brake system, the ABS must control the RBS.		Plan the analysis and the development of braking system according to the operation mode of the RBS. Item definition: consider the interactions between RBS and ABS (w.r.t. interfacing and system definition in ISO 26262) Control of RBS by ABS (if RBS is always active, also in neutral without any means to disconnect it by the driver) Verify that ABS control RBS in the case of failure of ABS
S5.2	S5. Equipment requirements. S5.2. Parking brake system. Each vehicle shall be equipped with a parking brake system of a friction type with solely mechanical means to retain engagement.		Is a pawl parking brake allowed?
S5.5.1	S5.5.1. Activation. An indicator shall be activated when the ignition (start) switch is in the ‘‘on’’ (‘‘run’’) position and whenever any of conditions (a) through (g) occur: (omissis) (g) For an EV with a regenerative braking system that is part of the service brake system, failure of the RBS.	Modeling HMI interface for visual indicators	Include diagnostics task related to RBS, in order to transmit information to the visual warning indicator Designing proper warning in the case of failure of brake power supply, reduced SoC, RBS failure
S6.3.12	S6.3.12 State of charge of batteries for electrically-actuated service brakes. (Stopping distance tests at battery depleted state of charge)		Plan a braking test in depleted battery state-of-charge condition Analyze power management and warning of brake system supply battery, to ensure brake operation, motor shutdown and warning at battery depleted state of charge

EN 61851-1

Electric vehicle conductive charging system – Part 1: General requirements

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
6.3	Types of EV connection		Definition of charging system according to one of the 4 charging modes. Definition of the control pilot mandatory and optional functions (modes 2-4), including charging operation states.
7.1	Protection against electric shock		Define and provide measures to prevent electric shock both in normal service and in case of fault.
7.2.2	Stored energy – discharge of capacitors	Analyze the voltage transient of any accessible part after EV disconnection	Design the EV voltage input in such a way to control the voltage decay after EV disconnection.

EN 61851-1

Electric vehicle conductive charging system – Part 21: Electric vehicle requirements for conductive connection to an AC/DC supply

Std. ref.	Requirement of the standard	Requ. to system desc. and modeling	Requirement to design methodology
7.3	Detection of the electrical continuity of the protective conductor		Design a monitoring system to detect the electrical continuity of the protective conductor during charging modes 2, 3 and 4.
8.1.1	Dielectric withstand voltage		Design the on board charging equipment as to withstand the test voltage at any input connection (2U +1000 V, min. 1500 V AC). Design all vehicle equipment as to withstand a test voltage of 4kV between AC or DC input and low voltage inputs (if any).
8.1.2	Electric vehicle insulation resistance		Verify the insulation resistance (by analysis and testing). Minimum required: 1 MΩ.
10.1	Drive train interlock		Design a system to detect the connection of the mobile connector or that the plug and the cable have been stored in the vehicle. The system shall also inhibit the drive train.

J1772

SAE Electric Vehicle and Plug in Hybrid Electric Vehicle Conductive Charge Coupler

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
5. CONTROL AND DATA	5.3 Control Pilot functions 5.3.5 EVSE Current Capacity The EVSE communicates the maximum available continuous current capacity to the EV/PHEV by modulating the pilot duty cycle as described in Table 6A, Table 6B and shown in Figure 7. The EVSE may accept an external signal to vary the duty cycle for supply or premises power limitations. The EV/PHEV vehicle shall use the duty cycle to control the on-board charger AC current drawn from the line.	Model communication protocol based on PWM and signal amplitude (by switching a resistor)	Design the hardware-software communication of control pilot
5.4	5.4 Proximity Detection Upon insertion of the connector into the vehicle inlet, the coupler shall provide a means to detect the presence of the connector In the vehicle Inlet as described In Table 7 and shown in Figure 8.		Design the management of the connector detection signal: to start charge control, to engage drive train interlock, to reduce charge load during disconnection
5.5	5.5 Digital Data Transfer		Design the communication according to the standard (charging station status, power level, fault conditions)
5.6	5.6 Typical Start Up Sequence		Design the charging state machine according to the standard, including safe states in the case of fault.
9	9. CHARGE STATUS INDICATOR The PHEV shall provide charge status information visible to the operator while inserting the coupler into the vehicle inlet... This indicator, as well as the AC Present Indicator on the EVSE (7.4) should be considered part of a diagnostic strategy that helps determine possible causes of no-charge events. This diagnostic strategy is optional for battery electric vehicles.		Define the charge status indicator, including diagnostic functions.

Regulation No. 13-H
Uniform provisions concerning the approval of passenger cars with regard to braking

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
5.2.7.	In the case of vehicles equipped with electric regenerative braking systems of category B, the braking input from other sources of braking, may be suitably phased to allow the electric regenerative braking system alone to be applied, provided that both the following conditions are met: 5.2.7.1. Intrinsic variations in the torque output of the electrical regenerative braking system (e.g. as a result of changes in the electric state of charge in the traction batteries) are automatically compensated by appropriate variation in the phasing relationship as long as the requirements 3/ of one of the following annexes to this Regulation are satisfied: Annex 3, paragraph 1.3.2., or Annex 6, section 5.3. (including the case with the electric motor engaged), and 5.2.7.2. Wherever necessary, to ensure that braking rate 3/ remains related to the driver's braking demand, having regard to the available tire/road adhesion, braking shall automatically be caused to act on all wheels of the vehicle.		If the RBS is part of service brake, design the braking inputs, compensating the variations of the regenerative braking and ensuring breaking action in all wheels.
5.2.10	5.2.10. The service, secondary and parking braking systems must act on braking surfaces connected to the wheels through components of adequate strength. Where braking torque for a particular axle or axles is provided by both a friction braking system and an electrical regenerative braking system of category B, disconnection of the latter source is permitted, providing that the friction braking source remains permanently connected and able to provide the compensation referred to in paragraph 5.2.7.1.		In case of category B, analyze (by simulation and testing) the compensation transients to verify that it is attained within the required time and value limits
5.2.18.5.	For vehicles equipped with an anti-lock device, the anti-lock device must control the electric braking system.		Include a development task to define and manage the interaction between ABS and RBS.

J2344

Guidelines for Electric Vehicle Safety

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
4.2	Single-Point Failure A single-point hardware/software failure or single failure of trained personnel to follow documented procedures should not result in an unreasonable safety risk to any person		This point is fully addressed by ISO 26262. Failure of trained personnel may be considered as a misuse, which shall be included in the hazard analysis.
4.3	Electric safety Protection against hazardous levels of electrical voltage or current. Means should be provided to detect degraded insulation. Process and/or hardware should be provided to allow for controlled access to the high-voltage system. Alternative means to be used: Automatic Hazardous Voltage Disconnect, Manual Disconnect, Interlock Systems, Tools, Grounding.		Design a monitoring system to detect insulation degradation. Define procedures and/ or design hardware to control the access to high voltage system.
4.3.1	Electric Insulation Insulation resistance for DC and AC circuits: 100 or 500 Ω/V Insulation resistance in the case of DC and AC systems conductively connected: 500 Ω/V, unless barriers are provided.		Design the high voltage insulation according to the requirements.
4.3.2	High Voltage Withstand Capability Testing for design verification (test voltages and test procedures)		Design high voltage system to withstand test voltage. Plan testing to demonstrate high voltage withstands capability.
4.3.3.1.1	Vehicle Crash Sensor Crash sensor to actuate a disconnect Qualification of the crash sensor		Design a crash sensor, properly qualified to operate in the crash tests. Design the disconnect to be activate by the crash sensor and to maintain disconnection after crash.
4.3.3.1.2	Detected Loss of High Voltage Insulation Actuation in non-motoring mode		Design the disconnect to be activated only in non-motoring mode, in the case of loss of insulation.

Std. ref.	Requirement of the standard	Requirement to system description and modeling	Requirement to design methodology
4.3.3.1.3	Hazardous Voltage Interlock Loop (HVIL)		Design an interlock loop connecting access panels, connectors, service disconnect, etc.
4.3.3.1.4	Overcurrent Actuation of the disconnect by overcurrent condition as a primary or secondary overcurrent protection		Design the disconnect to be operated by an overcurrent condition (as primary or secondary protection).
4.3.3.2	Other Automatic Disconnect Function Guidelines • location of the automatic disconnect • deliberate reset • diagnostics • fail-safe operation • associated supply voltages • output signal		Design the disconnect according to the design guidelines.
4.3.4	Manual Disconnect • location • single/two-pole • operation		Design the manual disconnect
4.3.7	Grounding grounding of conductive cases direct or indirect grounding		Design grounding of the conductive cases, also by means of indirect connection.
4.4	Fault Monitoring • indication of faults • operation in the case of faults		Design the vehicle control system to avoid that the vehicle operator persists in the case of fault
4.11	Mechanical safety • shift mechanism with/without “Park” position (parking pawl)		Design a lock system activated when the shift mechanism is in P position or the key is in “off” position.
4.12	Rechargeable Energy Storage System State-of-Charge • performance of the critical safety systems • separate indicator		Design the operation in low state-of-charge in such a way that - the performance of the critical safety systems is not degraded - the state is indicated in a separate indicator if the vehicle performance is reduced

The following tables collect the “medium level user requirements” derived from the high level user requirements. The requirements are the results of the analysis of the standards and regulations concerning EVs and relevant to MAENAD objectives.

The requirements refer to specific subjects of the norms and are classified in three different categories (language/modeling, analysis, methodology), in order to easily establish links with the WPs that will be in charge of the implementation. The methodology requirements will be considered to define the development process (“methodology”) which will be reported in D 2.2.1.

O1. Modelling and analysis support, following ISO		O2. Prediction of dependability & performance		O3. Design optimization		O4. Case Study: Application on FEV and evaluation of engineering methods				High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)
O1-1:	O1-2:	O2- 1:	O2-2:	O3-1:	O3-2:	O4-1:	O4-2:	O4-3:	O4-4:	Ref.		Subject
✔						✔			✔	4SG 7	EV safety standards/ ISO 6469-1	Insulation
						✔			✔			Heath generation
✔						✔			✔			RESS over-current interruption
						✔			✔	4SG 8	EV safety standards/ ISO 6469-2	Connection of the vehicle to an off-board electric
						✔			✔			Indication of reduced power
						✔			✔			Driving backwards
						✔			✔			Parking
						✔			✔			Protection against failures
						✔			✔	4SG 9	EV safety standards/ ISO 6469-3 Protection of persons against electric hazards	Protection of persons against electric shock
						✔			✔			Alternative approach for protection against electric
✔						✔			✔			Isolation resistance requirements
✔						✔			✔			Requirements of potential equalization
						✔			✔			Charging inlet disconnection
						✔			✔			Grounding and isolation resistance requirement
✔						✔			✔	4SG 10	EV safety standards/ EN 1987-1	
✔						✔			✔	4SG 11	EV safety standards/ EN 1987-2	
						✔			✔	4SG 12	EV safety standards/ EN 1987-3	
						✔			✔	4SG 13	EV safety standards/ J2344	Electric isolation
						✔			✔			High Voltage Automatic Disconnect System
						✔			✔			High Voltage Manual Disconnect System
						✔			✔			Grounding
						✔			✔			Fault monitoring
						✔			✔			Rechargeable Energy Storage System State-of-
						✔			✔			Mechanical safety
						✔			✔	4SG 14	EV safety standards/ UL 2231-1	
						✔			✔	4SG 15	EV safety standards/ UL 2231-2	

Table 5 – User and medium level requirements related to EV standards and regulations, and MAENAD objective coverage matrix (part 1)

O1. Modelling and analysis support, following ISO		O2. Prediction of dependability & performance		O3. Design optimization		O4. Case Study: Application on FEV and evaluation of engineering methods				High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)
O1-1:	O1-2:	O2- 1:	O2-2:	O3-1:	O3-2:	O4-1:	O4-2:	O4-3:	O4-4:	Ref.		Subject
						✔			✔	4SG 16	EV safety standards/ EN 61851	Types of EV connection
						✔			✔			Protection against electric shock
	✔					✔			✔			Stored energy – discharge of capacitors
						✔			✔			Detection of the electrical continuity of the protective
						✔			✔			Dielectric withstand voltage
						✔			✔			Electric vehicle insulation resistance
						✔			✔			Drive train interlock
						✔			✔	4SG 18	EV safety standards/ J2289	Vehicle operational modes
✔						✔			✔			Key-on discharge
✔						✔			✔			Key-on Regen operation
✔						✔			✔			Key on – Charge
✔						✔			✔			Key-Off Parked Off Plug Operating
✔						✔			✔			Parked Off Plug IDLE/Storage Operation
✔						✔			✔			
✔						✔			✔			Discharge management - Performance limits
						✔			✔			Charge management
✔						✔			✔			Key-on startup diagnostics and warning
						✔			✔			Service diagnostics
						✔			✔			Toxic emissions Flammable gasses
✔						✔			✔	4SG 72	FMVSS No. 114 Theft protection	Keylocking device
						✔			✔			Parking function
						✔			✔	4SG 73	FMVSS No. 102 Transmission shift lever	
						✔			✔	4SG 75	R 116 Theft protection	Locking device
						✔			✔			Locking function

Table 6 – User and medium level requirements related to EV standards and regulations, and MAENAD objective coverage matrix (part 2)

O1. Modelling and analysis support, following ISO		O2. Prediction of dependability & performance		O3. Design optimization		O4. Case Study: Application on FEV and evaluation of engineering methods				High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)
O1-1:	O1-2:	O2- 1:	O2-2:	O3-1:	O3-2:	O4-1:	O4-2:	O4-3:	O4-4:	Ref.		Subject
			✔	✔	✔	✔	✔		✔	4SG 19	EV performance standards/ ISO 8715	Performance testing - Terms and definitions
			✔	✔	✔	✔	✔		✔			Performance testing - Test conditions and procedures
			✔	✔	✔	✔	✔		✔	4SG 20	EV performance standards/ ISO 8714	Energy and range testing - Terms and definitions
			✔	✔	✔	✔	✔		✔			Energy and range testing - Test conditions and procedures
			✔	✔	✔	✔	✔		✔		EV performance standards/ EN 1821-1	Performance testing
			✔	✔	✔	✔	✔		✔	4SG 22	EV performance standards/ EN 1986-1	Energy and range testing
			✔	✔	✔	✔	✔		✔	4SG 23	EV performance standards/ ISO 12405-2	Terms and definitions
			✔	✔	✔	✔	✔		✔			Test sequence - Test conditions
			✔	✔	✔	✔	✔		✔			Test sequence - Test procedures
									✔		EV communication standards/ ISO 15118	
									✔		EV communication standards/ J2836	
									✔		EV communication standards/ J2847	
									✔	4SG 74	SAE J2777 Conductive charge coupler	Control pilot
									✔			Proximity detection
									✔			Charge management
									✔			Charge status indicator
									✔	4SG 70	R 13H Braking	Phasing of braking sources (B category)
									✔			Integration with ABS

Table 7 – User and medium level requirements related to EV standards and regulations, and MAENAD objective coverage matrix (part 3)

High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)						
Ref.		Subject	Language/Modelling	Req. ref.	Analysis	Req. ref.	Methodology	Req. ref.
4SG 7	EV safety standards/ ISO 6469-1	Insulation	- Insulation symbols - Insulation attributes (withstand	4SG76	Insulation analysis (overall resistance,	4SG77	- Deployment of insulation resistance - Addressing insulation monitoring	4SG78
		Heath generation					Designing a monitoring system to prevent dangerous effects to persons,	4SG79
		RESS over-current interruption	Modelling of an over-current interruption device	4SG80	RESS short circuit analysis (current	4SG81	- Designing an overcurrent interruption device	4SG82
4SG 8	EV safety standards/ ISO 6469-2	Connection of the vehicle to an off-board electric					Designing a means to make impossible to move the vehicle when connected to	4SG83
		Indication of reduced power					Designing a warning to signal to the driver that the propulsion power is	4SG84
		Driving backwards					Designing means to prevent unintentional switching in reverse	4SG85
		Parking					Designing a warning to indicate whether propulsion is in the	4SG86
		Protection against failures					In functional safety development, include unintended acceleration,	4SG87
4SG 9	EV safety standards/ ISO 6469-3 Protection of persons against electric hazards	Protection of persons against electric shock					Designing mechanical and electronics means according to the standard.	4SG88
		Alternative approach for protection against electric					Conduct an appropriate hazard analysis with respect to electric shock and	4SG89
		Isolation resistance requirements	See insulation requirements (ISO 6469-1)	NA			Assignment of insulation resistance to high voltage components as to achieve	4SG90
		Requirements of potential equalization	Represent bonding/grounding of physical elements (proper symbols)	4SG91			Designing insulation barriers and bonded conductive equalization	4SG92
		Charging inlet disconnection			Analysis of charging inlet voltage	4SG93	Designing charge system, as to ensure voltage decrease of inlet according to	4SG94
		Grounding and isolation resistance requirement					Designing charging system as to meet insulation requirements in the case of	4SG95
4SG 10	EV safety standards/ EN 1987-1		See ISO 6469-1					
4SG 11	EV safety standards/ EN 1987-2		See ISO 6469-1					
4SG 12	EV safety standards/ EN 1987-3							
4SG 13	EV safety standards/ J2344	Electric isolation	See 4SG76				- Design the high voltage insulation (100 ohm/V DC, 500 ohm/V AC)	4SG160
		High Voltage Automatic Disconnect System					- Design an automatic disconnect system actuated:	4SG161
		High Voltage Manual Disconnect System					- Design a manual disconnect system actuated by an interlock loop	4SG162
		Grounding					- Design grounding of the conductive cases containing high voltage systems,	4SG163
		Fault monitoring					- Design a fault monitoring system - Design the vehicle operation in such a	4SG164
		Rechargeable Energy Storage System State-of-					- Design the operation in low state-of-charge in such a way that	4SG165
		Mechanical safety					- Design a lock system activated when the shift mechanism is in P position or	4SG166
4SG 14	EV safety standards/ UL 2231-1							
4SG 15	EV safety standards/ UL 2231-2							

Table 8 – Medium level requirements related to EV standards and regulations, addressing language, analysis and methodology (part 1)

High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)						
Ref.		**Subject**	**Language/Modelling**	**Req. ref.**	**Analysis**	**Req. ref.**	**Methodology**	**Req. ref.**
4SG 16	EV safety standards/ EN 61851	Types of EV connection					- Define the charging system according to one of the 4 charging modes.	4SG96
		Protection against electric shock					Define and provide measures to prevent electric shock both in normal	4SG97
		Stored energy – discharge of capacitors			Analyze the voltage transient of any	4SG98	Design the EV voltage input in such a way to control the voltage decay after	4SG99
		Detection of the electrical continuity of the protective					Design a monitoring system to detect the electrical continuity of the	4SG100
		Dielectric withstand voltage					Design the on board charging equipment as to withstand the test	4SG101
		Electric vehicle insulation resistance					Verify the insulation resistance (by analysis and testing). Minimum	4SG102
		Drive train interlock					Design a system to detect the connection of the mobile connector or	4SG103
4SG 18	EV safety standards/ J2289	Vehicle operational modes					- Defining the vehicle operational modes	4SG104
		Key-on discharge	- Modelling the power supply network including fault protection	4SG105	- Power and energy analysis to estimate	4SG106	- Assessment of battery capability to match the vehicle demand (range,	4SG107
		Key-on Regen operation	- Include voltage limit data/requirements of the drive	4SG108	Analysis of voltage transients during	4SG109	- Assessing the compliance of the voltage with the limits during	4SG110
		Key on – Charge	- Include electrical characteristics of the charge system components (e.g.	4SG111	Matching analysis of power equipment	4SG112	- Verifying that all charge system components match w.r.t. electrical	4SG113
		Key-Off Parked Off Plug Operating	- Include the power characteristics of the devices running in key-off mode	4SG114	Power requirement analysis in key-off	4SG115	- Providing energy management to prevent excessive discharge due to	4SG116
		Parked Off Plug IDLE/Storage Operation	- Modelling the battery disconnect system (mechanical switch)	4SG117			Designing a battery disconnect system for operation during storage or	4SG118
							- Designing contactor operation as to be deactivated in the case of crash or	4SG119
		Discharge management - Performance limits	Include the operation limits of the battery (temperature ranges, current,	4SG120			Designing BMS to protect for overtemperature, under-temperature,	4SG121
		Charge management					Design communication in compliance with SAE J1772, SAE J1773, and SAE	4SG122
		Key-on startup diagnostics and warning	Represent different levels of warnings (depending on the fault	4SG123			Design key-on running diagnostics and warning procedures	4SG124
		Service diagnostics					Design service diagnostics	4SG125
		Toxic emissions Flammable gasses					Consider toxic emissions and flammable gasses caused by battery	4SG126
4SG 72	FMVSS No. 114 Theft protection	Keylocking device	Model a keylocking device with lock and unlock conditions	4SG127			Design the keylocking system to prevent the activation of the motor and	4SG128
		Parking function					- Design the operation of keylocking system according to the standard (see	4SG129
4SG 73	FMVSS No. 102 Transmission shift lever						Designing the shift lever according to the sequence position and rotation	4SG130
4SG 75	R 116 Theft protection	Locking device					Designing devices to prevent unauthorized use (deactivation of	4SG131
		Locking function					Conduct functional safety analyses to cover the devices intended to prevents	4SG132
4SG 71	FMVSS No. 135 Passenger car brake systems	Regenerative braking system					- Plan the analysis and the development of braking system	4SG133
		Diagnostics and warning	Modelling HMI interface for visual indicators	4SG134			- Include diagnostics task related to RBS, in order to transmit information to	4SG135
		Braking performance			Analyze power management and	4SG136	Plan a braking test in depleted battery state-of-charge condition	4SG137

Table 9 – Medium level requirements related to EV standards and regulations, addressing language, analysis and methodology (part 2)

High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)						
Ref.		Subject	Language/Modelling	Req. ref.	Analysis	Req. ref.	Methodology	Req. ref.
4SG 19	EV performance standards/ ISO 8715	Performance testing - Terms and definitions	Define vehicle performance characteristics according to the terms	4SG138				
		Performance testing - Test conditions and	Define the test cases according to the test conditions and test procedures	4SG139	Simulate vehicle performance	4SG140	Include the simulation of vehicle performance according to test	4SG141
4SG 20	EV performance standards/ ISO 8714	Energy and range testing - Terms and definitions	Define vehicle energy consumption and range characteristics according to	4SG142				
		Energy and range testing - Test conditions and	Define the test cases according to the test conditions and test procedures	4SG143	Simulate vehicle energy	4SG144	Include the simulation of vehicle performance according to test	4SG145
	EV performance standards/ EN 1821-1	Performance testing	See ISO 8715					
4SG 22	EV performance standards/ EN 1986-1	Energy and range testing	See ISO 8714					
4SG 23	EV performance standards/ ISO 12405-2	Terms and definitions	Define battery model parameters according to the test purpose (e.g.	4SG146				
		Test sequence - Test conditions	Modelling – Comply with test conditions requirements (e.g. battery	4SG147			- Simulate vehicle performance according to test conditions	4SG148
		Test sequence - Test procedures			Define test case for simulation	4SG149		
	EV communication standards/ ISO 15118							
	EV communication standards/ J2836							
	EV communication standards/ J2847							
4SG 74	SAE J2777 Conductive charge coupler	Control pilot	Model communication protocol based on PWM and signal amplitude	4SG150			Design the communication according to the standard (charging station status,	4SG151
		Proximity detection					Design the management of the connector detection signal: to start	4SG152
		Charge management					Design the charging state machine according to the standard, including	4SG153
		Charge status indicator					Define the charge status indicator, including diagnostic functions.	4SG154
4SG 70	R 13H Braking	Phasing of braking sources (B category)			Analyze (e.g. by simulation) the	4SG155	If the RBS is part of service brake, design the braking inputs,	4SG156
		Integration with ABS					Include a development task to define and manage the interaction between	4SG157

Table 10 – Medium level requirements related to EV standards and regulations, addressing language, analysis and methodology (part 3)

5 Hints for requirement validation

To the purpose to define the validation activities of MAENAD, which will be part of WP6, MAENAD can be considered as a development project of software tools, besides the research contents that are fundamental.

Moreover, if the MAENAD tools will be exploited as a support for the development of E/E systems according to ISO 26262, one of the requirements of this ISO standard requires that the software tools are developed according to ISO 26262. The requirements of ISO 26262 include the software validation against the tool requirements. Therefore, the activity of WP6 should include such a validation. Figure 6 shows the above concept, and the validation activity can be also seen as a V-cycle, in which some activities are covered by MAENAD objectives and are performed with demonstrators to verify the description and modeling capability of EAST-ADL, and to exercise the tools, following an ideal design flow of an EV (whose demonstrators cover some specific aspects) including functional safety process.

In addition, another requirement of ISO 26262 requires that the tools are validated on the base of a test case whose results are known. This requirement suggests conceiving the case studies in such a way to verify the demonstration results predictably.

Table 11 shows a preliminary table to link the requirements to the tools and to the demonstrations, in order to verify whether and how the requirements will be validated.

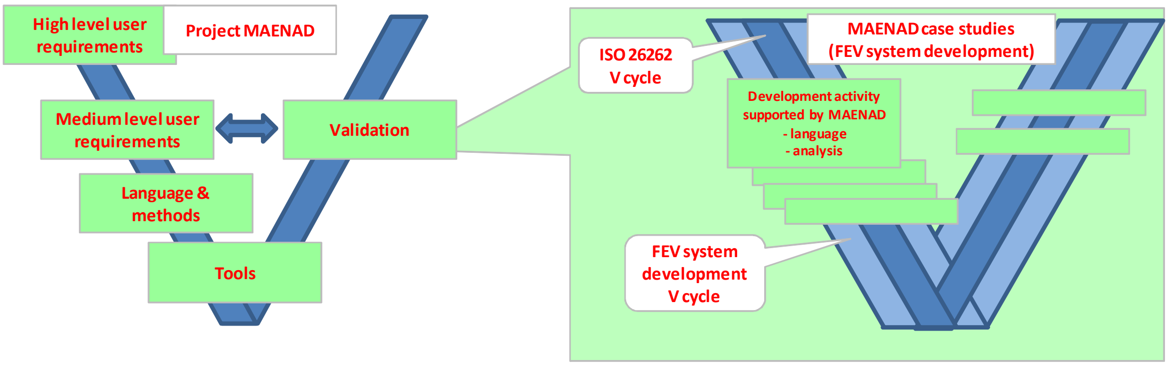


Figure 6 – MAENAD as a development process, in which WP6 is the validation phase

High level user requirement		Medium level user requirement (the text may be more extensive than shown in the box)							Tools	Validation criteria			Validator		
Ref.		Subject	Language/Modelling	Req. ref.	Analysis	Req. ref.	Methodology	Req. ref.		Implem	Complet	Easy of	Demo 1	Demo 2	Demo 3
4SG 7	EV safety standards/ ISO 6469-1	Insulation	- Insulation symbols - Insulation attributes (withstand		Insulation analysis (overall resistance,		- Deployment of insulation resistance - Addressing insulation monitoring								
		Heath generation					Designing a monitoring system to prevent dangerous effects to persons,								
		RESS over-current interruption	Modelling of an over-current interruption device		RESS short circuit analysis (current		- Designing an overcurrent interruption device								
4SG 8	EV safety standards/ ISO 6469-2	Connection of the vehicle to an off-board electric					Designing a means to make impossible to move the vehicle when connected to								
		Indication of reduced power					Designing a warning to signal to the driver that the propulsion power is								
		Driving backwards					Designing means to prevent unintentional switching in reverse								
		Parking					Designing a warning to indicate whether propulsion is in the								
		Protection against failures					In functional safety development, include unintended acceleration,								

Table 11 – Validation matrix exemplum

6 Engineering Scenarios

Engineering scenarios as described in this section represent use cases or scenarios that an engineer shall be able to perform using MAENAD technology. Use cases are defined based on the challenges and objectives of the project as defined in the Description of Work. Requirements for the project and its results (language, methodology and tooling) can thus be drawn from the use cases.

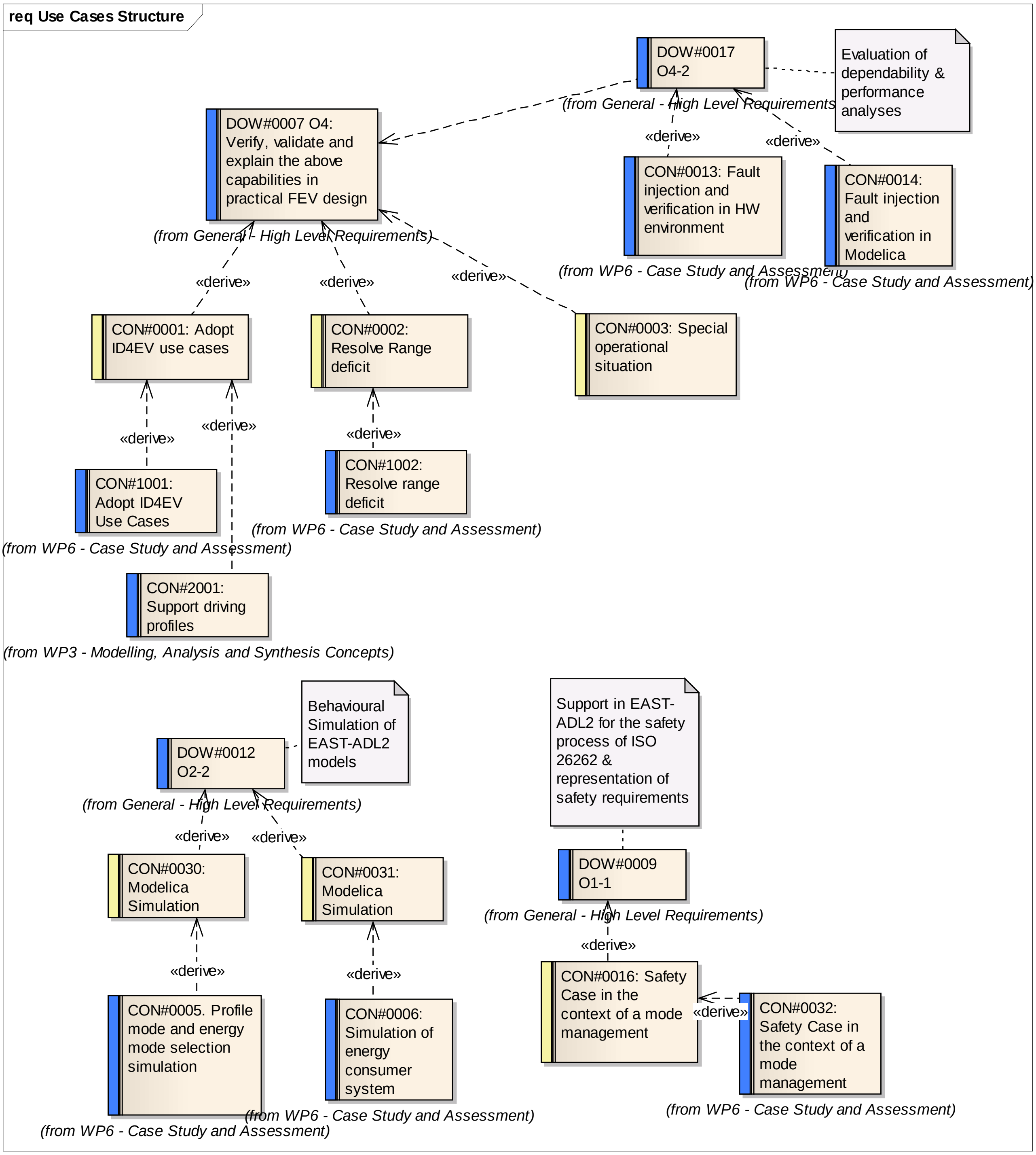


Figure 7: Use Cases Structure

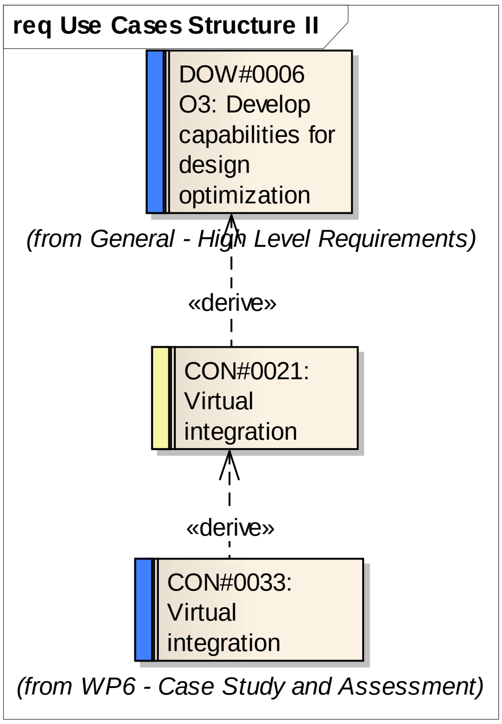


Figure 8: Use Cases Structure II

CON#0001: Adopt ID4EV use cases	
Alias	Adopt ID4EV use cases
Status	Addressed
Status Comment	In the functional design and the architecture use cases of ID4EV were considered (see D6.1.2 chapter 2.2.3).
Type	«Use Case»
Priority	High
Description	Adopt driving profiles of ID4EV project (Travel, City, Commuter, FUN, Limp Home) and related use cases. 2 derived requirements: 1) WP3: Clarify whether we need language extensions for supporting driving profiles (CON#2001) 2) WP6: Case Study shall adopt driving profiles of ID4EV project (CON#1001)
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

CON#0002: Resolve Range deficit	
Alias	Resolve Range deficit
Status	Addressed
Status Comment	The use case resolve range deficit was considered in the architecture and in timing analysis models (see D6.1.2 chapter 2.2.3).
Type	«Use Case»
Priority	High
Description	Adopt use case range problem solving for critical energy situations of ID4EV project.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

CON#0003: Special operational situation	
Alias	Special operational situation
Status	Addressed
Status Comment	Addressed by the mode and behavioral elements (see D6.1.2 chapter 2.2.3).
Type	«Use Case»
Priority	High
Description	Integration of special operational situations on vehicle level in profile/energy mode management (parking, stop&go; backward driving; not part of ID4EV). In general, it is about mode management in EAST-ADL.
Derived from	• DOW#0005 O2: Develop capabilities for prediction of dependability & performance

CON#0016: Safety Case in the context of a mode management	
Alias	Safety Case in the context of a mode management
Status	Rejected
Status Comment	A safety case related to mode and range management could not be found or was considered outside of its scope.
Type	«Safety»
Priority	High
Description	Define safety cases in the context of a global mode management. Comment: This is a UC, can be related to the "driving profiles" UC. There is a derived requirement for WP6 (CON#0032).
Derived from	• DOW#0009 O1-1

CON#0021: Virtual integration	
Alias	Virtual integration
Status	Addressed
Status Comment	Modelica was not good at providing a simulation container for AUTOSAR like models. Global optimizations contradict to the modular system approach of AUTOSAR. During the project Modelica was replaced with Yakindu and a fully implemented PC simulation in C. The system was tested in this environment prior to deployment (see D6.1.2 chapter 2.2.5).
Type	«Use Case»
Priority	Medium
Description	Virtual integration is an important use case during development within the ID4EV project. It is obvious that the physical demonstrator will not be available for a long time and the SW modules must be integrated in a virtual environment. The Modelica simulation environment is very well suited for integration C-code into the simulation environment.
Derived from	• DOW#0006 O3: Develop capabilities for design optimization

CON#0030: Simulation for AUTOSAR like systems	
Alias	Simulation for AUTOSAR like systems

Status	Addressed
Status Comment	Modelica was not good at providing a simulation container for AUTOSAR like models. Global optimizations contradict to the modular system approach of AUTOSAR. During the project Modelica was replaced with Yakindu and a fully implemented PC simulation in C (see D6.1.2 chapter 2.2.5).
Type	«Use Case»
Priority	Medium
Description	Provide a Modelica simulation model for a profile and mode selection logic (done within ID4EV project).
Derived from	• DOW#0012 O2-2

CON#0031: Simulation for AUTOSAR like systems	
Alias	Simulation for AUTOSAR like systems
Status	Addressed
Status Comment	Modelica was not good at providing a simulation container for AUTOSAR like models. Global optimizations contradict to the modular system approach of AUTOSAR. During the project Modelica was replaced with Yakindu and a fully implemented PC simulation in C (see D6.1.2 chapter 2.2.5).
Type	«Use Case»
Priority	Medium
Description	Provide a Modelica simulation model for a energy consumer system (mode manager clients) (initial model sample provided by ID4EV).
Derived from	• DOW#0012 O2-2

KTH#0009: Using CMM compatible tools	
Alias	Using CMM compatible tools
Status	Addressed
Status Comment	Dissemination of EAST-ADL as a means to use ARTEMIS-RTP.
Type	«Use Case»
Priority	Medium
Description	The engineer can use CMM compatible tools to work with (analyze, simulate ...) EAST-ADL models. The complete CESAR eco-system is then available to the user.
Derived from	• KTH#0004 CMM_compatibility

KTH#0010: Tailoring of EAST-ADL2	
Alias	Tailoring of EAST-ADL2
Status	Addressed
Status Comment	Addressed by the modular structure and user defined attributes of the language (see D4.1.1).
Type	«Use Case»
Priority	Medium
Description	A company wants to adopt EAST-ADL2 partially, or add custom elements to EAST-ADL2.
Derived from	• KTH#0002 Language_Modularity

KTH#0011: Meta-model update	
Alias	Meta-model update
Status	Addressed
Status Comment	Addressed by the profile strategy, the EAST-ADL schema, and change appendix in D4.1.1 and D4.3.1.
Type	«Use Case»
Priority	Medium
Description	The meta-model is updated, and the corresponding models needs to be updated to cope with the changes in the meta-model. At least, models not affected by the change in the meta-model should be conserved.
Derived from	• KTH#0001 Language_Evolution

VTEC#UC001 Model exchange	
Alias	Model exchange
Status	Addressed
Status Comment	Addressed for HDA and FDA by MAENAD tooling and in general by EAXML schema (see D3.5.1 and D4.3.1).
Type	«Use Case»
Priority	Medium
Description	A model of the validator is defined in tool #1, exported to EAXML and imported in tool #2
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • WP6

VTEC#UC002 Model timing analysis	
Alias	Model timing analysis
Status	Addressed
Status Comment	Addressed by Papyrus/Qompass tool (see D5.2.1).
Type	«Use Case»
Priority	Medium
Description	A model of the validator with timing annotations is defined and exported to EAXML. A timing analysis tool imports the EAXML file and analyses the response times. The re-sulting response times are recorded in the model and exported in the EAXML file. The actual response times are compared with formalized requirements (timing constraints refining a requirement).
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • DOW#0005 O2: Develop capabilities for prediction of dependability & performance • DOW#0006 O3: Develop capabilities for design optimization • WP6

VTEC#UC003 Model dependability analysis	
Alias	Model dependability analysis
Status	Addressed
Status Comment	Addressed by EPM/HiP-HOPS and Metaedit+/HiP-HOPS (see D5.2.1 and D6.1.3).

Type	«Use Case»
Priority	Medium
Description	A model of the validator with dependability annotations is defined and exported to EAXML. A dependability analysis tool imports the EAXML file and analyses the dependability. The resulting dependability is recorded in the model and exported in the EAXML file. The actual dependability is compared with formalized requirement on dependability (quantitative safety constraints refining a requirement).
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262 • DOW#0005 O2: Develop capabilities for prediction of dependability & performance • DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • WP6

VTEC#UC004 Model fault tree analysis	
Alias	Model fault tree analysis
Status	Addressed
Status Comment	Addressed by EPM/HiP-HOPS and Metaedit+/HiP-HOPS (see D5.2.1 and D6.1.3).
Type	«Use Case»
Priority	Medium
Description	A model of the validator with dependability annotations is defined and exported to EAXML. A fault tree analysis tool imports the EAXML file and computes the fault tree. The resulting fault tree is recorded in the model (black box) and exported in the EAXML file.
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262 • DOW#0005 O2: Develop capabilities for prediction of dependability & performance • DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • WP6

VTEC#UC005 Model ASIL decomposition analysis	
Alias	Model ASIL decomposition analysis
Status	Addressed
Status Comment	Addressed by EPM/HiP-HOPS and Metaedit+/HiP-HOPS (see D5.2.1 and D6.1.3).
Type	«Use Case»
Priority	Medium
Description	A model of the validator with dependability annotations is defined and exported to EAXML. An ASIL decomposition tool imports the EAXML file and performs ASIL decomposition. The resulting ASIL annotation is recorded in the model (safety constraints) and exported in the EAXML file.
Derived from	• DOW#0010 O1-2 • DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • WP6

VTEC#UC006 Model optimization	
Alias	Model optimization

Status	Addressed
Status Comment	Addressed by EPM/OptiPal (see D5.2.1 and D6.1.3). Currently timing is not part of the optimization but energy consumption is considered instead.
Type	«Use Case»
Priority	Medium
Description	A model of the validator with timing, dependability and cost annotations as well as design space, variability and take rate annotations is defined and exported to EAXML. An optimization tool computes the optimal design for the defined product line. The resulting optimized model is recorded in the model (design space variability removed) and exported in the EAXML file.
Derived from	• DOW#0006 O3: Develop capabilities for design optimization • DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • DOW#0014 O3-1 • WP6

VTEC#UC007 Model Fault Injection	
Alias	Model Fault Injection
Status	Addressed
Status Comment	Addressed by using V&V support provided by EAST-ADL. The test procedure to be performed on the System Under Test during fault injection experiment is described as a VVProcedure, that provide means to define the stimuli to be performed on the SUT, the expected outcomes, the actual outcomes and to link them to model items (see D6.1.3).
Type	«Use Case»
Priority	Medium
Description	A model of a validator component executes in a MIL bench and is subject to fault injection according to a fault injection definition. The actual response is recorded in the model, exported to EAXML and is compared with expected outcome and with formalized requirements.
Derived from	• WP6 • DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design • DOW#0005 O2: Develop capabilities for prediction of dependability & performance • DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262

VTEC#UC008 Physical Fault Injection	
Alias	Physical Fault Injection
Status	Addressed
Status Comment	A test bench has been realized. The test equipment is able to inject faults at system level. A physical prototype of the SUT representing a typical FEV subsystem (propulsion) has been built. See D6.1.3 for more details.
Type	«Use Case»
Priority	Medium
Description	A physical prototype of a validator component is subject to fault injection in a physical FI bench, according to a fault injection definition. The actual response is recorded in the model and exported to EAXML. The actual response is compared with expected response. The actual response is compared with formalized requirements.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

	• WP6 • DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262 • DOW#0005 O2: Develop capabilities for prediction of dependability & performance

7 Requirements

7.1 General - High Level Requirements

MAENAD requirements are defined based on the challenges and objectives set out in the description of work. The Engineering Scenarios described in the previous chapter are also a source of requirements. As the Engineering Scenarios are defined to meet project objectives, all requirements can be organized according to the project challenges (Cx), objectives (Ox) and sub-objectives (Ox-y).

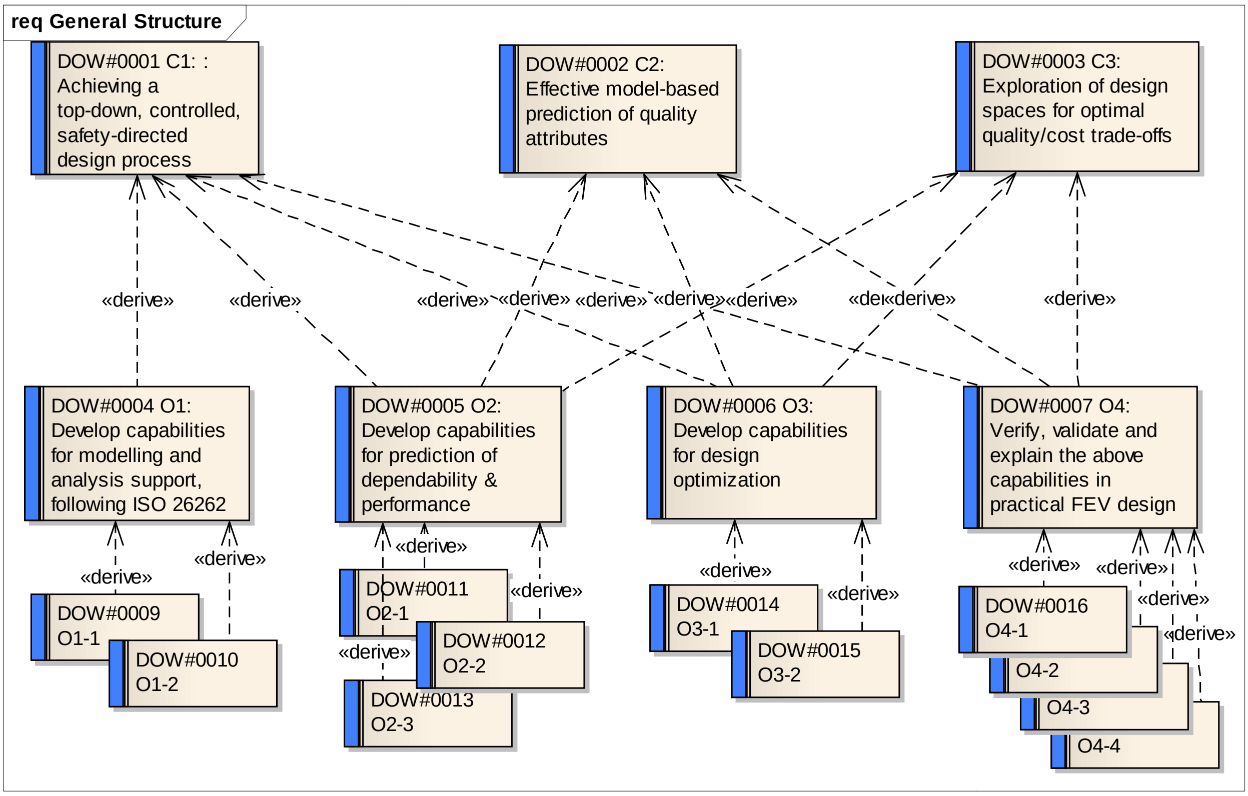


Figure 9: General Structure

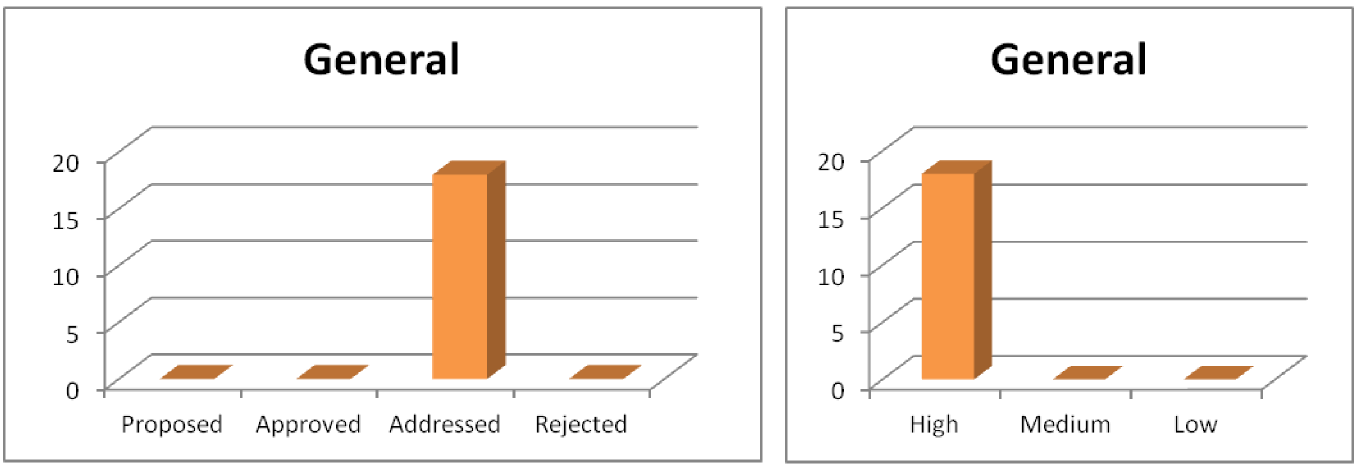


Figure 10: Status and priorities

DOW#0001 C1: : Achieving a top-down, controlled, safety-directed design process	
Alias	C1
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Achieving a top-down, controlled, safety-directed design process
Derived from	

DOW#0002 C2: Effective model-based prediction of quality attributes	
Alias	C2
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Effective model-based prediction of quality attributes
Derived from	

DOW#0003 C3: Exploration of design spaces for optimal quality/cost trade-offs	
Alias	C3
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Exploration of design spaces for optimal quality/cost trade-offs
Derived from	

DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262	
Alias	O1
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Develop capabilities for modeling and analysis support, following ISO 26262
Derived from	• DOW#0001 C1: : Achieving a top-down, controlled, safety-directed design process

DOW#0005 O2: Develop capabilities for prediction of dependability & performance	
Alias	O2
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Develop capabilities for prediction of dependability & performance
Derived from	• DOW#0001 C1: : Achieving a top-down, controlled, safety-directed design process • DOW#0003 C3: Exploration of design spaces for optimal quality/cost trade-offs • DOW#0002 C2: Effective model-based prediction of quality attributes

DOW#0006 O3: Develop capabilities for design optimization	
Alias	O3
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Develop capabilities for design optimization
Derived from	• DOW#0001 C1: : Achieving a top-down, controlled, safety-directed design process • DOW#0002 C2: Effective model-based prediction of quality attributes • DOW#0003 C3: Exploration of design spaces for optimal quality/cost trade-offs

DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design	
Alias	O4
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Verify, validate and explain the above capabilities in practical FEV design
Derived from	• DOW#0002 C2: Effective model-based prediction of quality attributes • DOW#0001 C1: : Achieving a top-down, controlled, safety-directed design process • DOW#0003 C3: Exploration of design spaces for optimal quality/cost trade-offs

DOW#0009 O1-1	
Alias	O1-1
Status	Addressed
Type	«Safety»
Priority	High
Description	Support in EAST-ADL2 for the safety process of ISO 26262 & representation of safety requirements
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262

DOW#0010 O1-2	
Alias	O1-2
Status	Addressed
Type	«Safety»
Priority	High
Description	Automatic allocation of safety requirements (ASILs)
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262

DOW#0011 O2-1	
Alias	O2-1
Status	Addressed
Type	«Reliability»
Priority	High
Description	Dependability analysis of EAST-ADL2 models (with new capabilities for multi-mode and temporal analysis of failures & integrated assessment of HW-SW design perspectives)
Derived from	• DOW#0005 O2: Develop capabilities for prediction of dependability & performance

DOW#0012 O2-2	
Alias	O2-2
Status	Addressed
Type	«Functional»
Priority	High
Description	Behavioral Simulation of EAST-ADL2 models
Derived from	• DOW#0005 O2: Develop capabilities for prediction of dependability & performance

DOW#0013 O2-3	
Alias	O2-3
Status	Addressed
Type	«Functional»
Priority	High
Description	Timing Analysis of EAST-ADL2 models
Derived from	• DOW#0005 O2: Develop capabilities for prediction of dependability & performance

DOW#0014 O3-1	
Alias	O3-1
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Extension of EAST-ADL2 language with semantics to support multi-objective optimization for product lines
Derived from	• DOW#0006 O3: Develop capabilities for design optimization

DOW#0015 O3-2	
Alias	O3-2
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Definition of a library of standard architectural patterns that can be automatically applied on an un-optimized EAST-ADL2 model in order to improve dependability and performance.
Derived from	• DOW#0006 O3: Develop capabilities for design optimization

DOW#0016 O4-1	
Alias	O4-1
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Evaluation of ability to support ISO 26262 and other standards influencing FEV
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0017 O4-2	
Alias	O4-2
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Evaluation of dependability & performance analyses
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0018 O4-3	
Alias	O4-3
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Evaluation of optimization approaches
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0019 O4-4	
Alias	O4-4
Status	Addressed
Type	«Non-Function»
Priority	High
Description	Evaluation of suitability of overall methodology for FEV design.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

7.2 WP1 - Project Management

This section lists the requirements related to the project and its execution.

TUB#2003 ChangeProcess	
Alias	ChangeProcess
Status	Addressed
Status Comment	MAENAD wiki and ticket system set up. This defines change process.
Type	«Collabor.»
Priority	High
Description	Change requests and the corresponding discussions in the project shall be managed in a transparent, organized process.
Derived from	• TUB#0003 ChangeProcess

TUB#2004 ChangeDocumentation	
Alias	ChangeDocumentation
Status	Addressed
Status Comment	MAENAD wiki and ticket system set up. This defines change documentation.
Type	«Collabor.»
Priority	Medium
Description	Change requests and the corresponding discussions shall be documented in a form that makes them accessible for reference in the future. Comment: see also TUB#2003
Derived from	• TUB#0004 ChangeDocumentation

7.3 WP2 - Needs and Methodology

WP2 requirements are those that relate to project requirements and methodology.

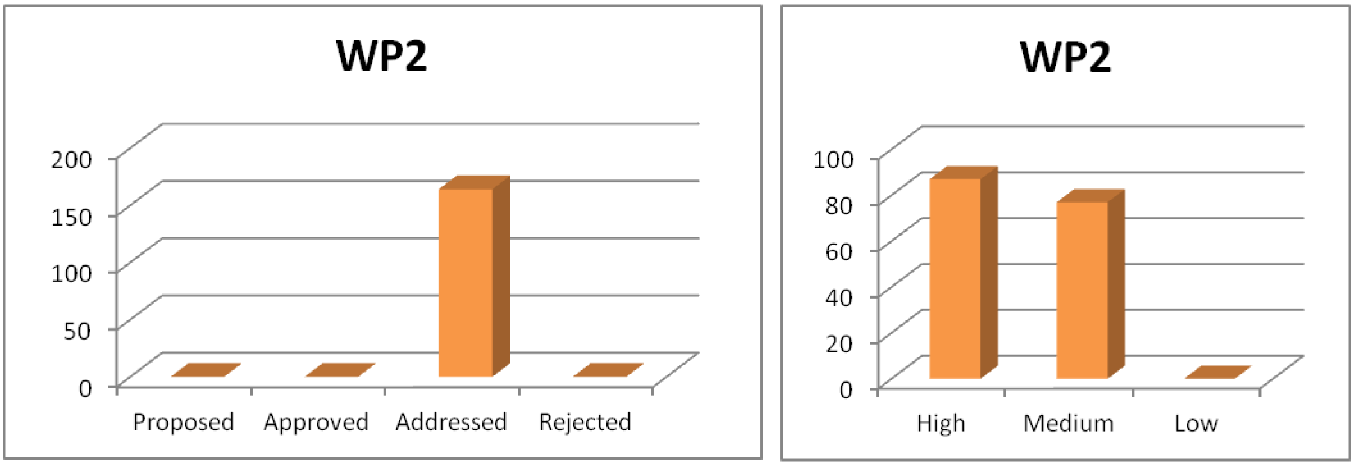


Figure 11: Status and priorities

4SG#0001: EV safety standards	
Alias	O1-1/ EV safety standards
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	Develop capability to follow ISO 26262, which requires applying the applicable standards.
Derived from	• DOW#0009 O1-1
Refined by	• 4SG#0007 … 4SG#0018

4SG#0002: EV regulations	
Alias	O1-1/ EV regulations
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	Apply applicable regulations, which are mandatory.
Derived from	• DOW#0009 O1-1
Refined by	• 4SG#0070 … 4SG#0075

4SG#0003: EV performance standards	
Alias	O2-2/ EV performance standards

Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	Perform behavioral Simulation of EAST-ADL2 models according to performance evaluation standards.
Derived from	• DOW#0012 O2-2
Refined by	• 4SG#0019 … 4SG#0023

4SG#0004: EV communication standards	
Alias	O2-2/ EV communication standards
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	Perform behavioral Simulation of EAST-ADL2 models according to standards covering communication with infrastructures. Comment: e.g. necessary during charging (payment, ensure ground connection, ...).
Derived from	• DOW#0012 O2-2
Refined by	• 4SG#0024 … 4SG#0026

4SG#0005: EV-specific issues	
Alias	O4-4/ EV-specific issues
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	Cover EV-specific issues in the design phase, in order to evaluate the suitability of overall methodology for FEV design.
Derived from	• DOW#0019 O4-4
Refined by	• 4SG#0027 … 4SG#0034, 4SG#0039

4SG#0007: ISO 6469-1	
Alias	EV safety standards/ ISO 6469-1
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall address ISO 6469-1: Electrically propelled road vehicles - Specific requirements for safety - Part 1: On board energy storage.
Derived from	• EV standards

	• 4SG#0001: EV safety standards
Refined by	• 4SG#0076 … 4SG#0082

4SG#0008: ISO 6469-2	
Alias	EV safety standards/ ISO 6469-2
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall address ISO 6469-2: Electric road vehicles - Safety specifications - Part 2: Vehicle operational safety means and protection against failures.
Derived from	• EV standards • 4SG#0001: EV safety standards
Refined by	• 4SG#0083 … 4SG#0087

4SG#0009: ISO 6469-3	
Alias	EV safety standards/ ISO 6469-3
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall address ISO 6469-3: Electric road vehicles - Safety specifications - Part 3: Protection of persons against electric hazards.
Derived from	• EV standards • 4SG#0001: EV safety standards
Refined by	• 4SG#0088 … 4SG#0095

4SG#0010: EN 1987-1	
Alias	EV safety standards/ EN 1987-1
Status	Addressed
Status Comment	The standard EN 1987-1 is equivalent to part of ISO 6469-1 which is addressed by requirement 4SG#0007.
Type	«Safety»
Priority	High
Description	The project shall address EN 1987-1: Electrically propelled road vehicles - Specific requirements for safety - Part 1: On board energy storage.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0011: EN 1987-2	
Alias	EV safety standards/ EN 1987-2
Status	Addressed
Status Comment	The standard EN 1987-2 is equivalent to part of ISO 6469-1 which is addressed by requirement 4SG#0007.

Type	«Safety»
Priority	High
Description	The project shall address EN 1987-2: Electrically propelled road vehicles - Specific requirements for safety - Part 2: Functional safety means and protection against failures.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0012: EN 1987-3	
Alias	EV safety standards/ EN 1987-3
Status	Addressed
Status Comment	The standard EN 1987-3 is equivalent to part of ISO 6469-1 which is addressed by requirement 4SG#0007.
Type	«Safety»
Priority	High
Description	The project shall address EN 1987-3: Electrically propelled road vehicles - Specific requirements for safety - Part 3: Protection of users against electrical hazards.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0013: J2344	
Alias	EV safety standards/ J2344
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall address J2344: Guidelines for Electric Vehicle Safety.
Derived from	• EV standards • 4SG#0001: EV safety standards
Refined by	• 4SG#0160 … 4SG#0166

4SG#0014: UL 2231-1	
Alias	EV safety standards/ UL 2231-1
Status	Addressed
Status Comment	This requirement concerns protection measures against electric shock, and is related especially to the charging station devices. Therefore this requirement is at borderline of Maenad. Nevertheless vehicle relevant parts are covered by MAENAD methodology.
Type	«Safety»
Priority	High
Description	The project shall address UL 2231-1: Personnel Protection Systems for EV Supply Circuits - Part 1: General.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0015: UL 2231-2

Alias	EV safety standards/ UL 2231-2
Status	Addressed
Status Comment	This requirement concerns protection measures against electric shock, and is related especially to the charging station devices. Therefore this requirement is at borderline of Maenad. Nevertheless vehicle relevant parts are covered by MAENAD methodology.
Type	«Safety»
Priority	High
Description	The project shall address UL 2231-2: Personnel Protection Systems for Electric Vehicle (EV) Supply Circuits: Particular Requirements for Protection Devices for Use in Charging Systems.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0016: EN 61851	
Alias	EV safety standards / EN 61851
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall address EN 61851: Electric vehicle conductive charging system - Part 1: General requirements; Part 21: Electric vehicle requirements for conductive connection to an AC/DC supply; Part 22: AC electric vehicle charging station EN 61851-22:2002.
Derived from	• EV standards • 4SG#0001: EV safety standards
Refined by	• 4SG#0096 … 4SG#0103

4SG#0017: J1766	
Alias	EV safety standards/ J1766
Status	Addressed
Status Comment	The electrical aspects addressed by this standard are limited to insulation requirements after crash. Therefore this requirement is at borderline of Maenad. The insulation aspects relevant to MAENAD purpose are covered by other standards.
Type	«Safety»
Priority	High
Description	The project shall address J1766: Recommended Practice for Electric and Hybrid Electric Vehicle Battery Systems Crash Integrity Testing.
Derived from	• EV standards • 4SG#0001: EV safety standards

4SG#0018: J2289	
Alias	EV safety standards/ J2289
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»

Priority	High
Description	The project shall address J2289: Electric Driver Battery Pack System Functional Guidelines.
Derived from	• EV standards • 4SG#0001: EV safety standards
Refined by	• 4SG#0104 … 4SG#0126

4SG#0019: ISO 8715	
Alias	EV performance standards/ ISO 8715
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to ISO 8715: Electric road vehicles - Road operating characteristics.
Derived from	• EV standards • 4SG#0003: EV performance standards
Refined by	• 4SG#0138 … 4SG#0141

4SG#0020: ISO 8714	
Alias	EV performance standards/ ISO 8714
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to ISO 8714: Electric road vehicles - Reference energy consumption and range - Test procedures for passenger cars and light commercial vehicles.
Derived from	• EV standards • 4SG#0003: EV performance standards
Refined by	• 4SG#0142 … 4SG#0145

4SG#0021: EN 1821-1	
Alias	EV performance standards/ EN 1821-1
Status	Addressed
Status Comment	The standard EN 1821-1 is equivalent to ISO 8715 which is addressed by requirement 4SG#0019.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to EN 1821-1: Electrically propelled road vehicles - Measurement of road operating ability - Part 1: Pure electric vehicles.
Derived from	• 4SG#0003: EV performance standards • EV standards

4SG#0022: EN 1986-1	
Alias	EV performance standards/ EN 1986-1
Status	Addressed
Status Comment	The standard EN 1986-1 is equivalent to ISO 8714 which is addressed by requirement 4SG#0020.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to EN 1986-1: Electrically propelled road vehicles - Measurement of energy. The project shall enable to performances - Part 1: Pure electric vehicles.
Derived from	• EV standards • 4SG#0003: EV performance standards

4SG#0023: ISO 12405-2	
Alias	EV performance standards/ ISO 12405-2
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to ISO 12405-2: Electrically propelled road vehicles - Test specification for lithium-ion traction battery packs and systems - Part 1: High energy applications.
Derived from	• EV standards • 4SG#0003: EV performance standards
Refined by	• 4SG#0146 … 4SG#0149

4SG#0024: ISO 15118	
Alias	EV communication standards/ ISO 15118
Status	Addressed
Status Comment	Addressed as design activity of FEV development process (FEV swimlane of MAENAD methodology).
Type	«Non-Function»
Priority	Medium
Description	The project shall enable to perform behavioral simulation according to ISO 15118: Road vehicles - Communication protocol between electric vehicle and grid - Part 1: Definitions and use-case, Part 2: Sequence diagrams and communication layers.
Derived from	• 4SG#0004: EV communication standards • EV standards

4SG#0025: J2836	
Alias	EV communication standards/ J2836
Status	Addressed
Status Comment	Addressed as design activity of FEV development process (FEV swimlane of MAENAD methodology). EAST-ADL is able to support behavioral simulation concerning commu-nication between vehicle and supply equipment including power flow analysis by using simulation tools such as Modelica.

Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation according to J2836: Use Cases for Communication between Plug-in Vehicles and the Utility Grid; Use Cases for Communication between Plug-in Vehicles and the Supply Equipment (EVSE); Use Cases for Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow.
Derived from	• 4SG#0004: EV communication standards • EV standards

4SG#0026: J2847	
Alias	EV communication standards/ J2847
Status	Addressed
Status Comment	Addressed as design activity of FEV development process (FEV swimlane of MAENAD methodology). EAST-ADL is able to support behavioral simulation concerning communication between vehicle and supply equipment including power flow analysis by using simulation tools such as Modelica.
Type	«Non-Function»
Priority	Medium
Description	The project shall enable to perform behavioral simulation according to J2847: Communication between Plug-in Vehicles and the Utility Grid; Communication between Plug-in Vehicles and the Supply Equipment (EVSE); Communication between Plug-in Vehicles and the Utility Grid for Reverse Power Flow.
Derived from	• 4SG#0004: EV communication standards • EV standards

4SG#0027: High voltage	
Alias	EV-specific issues/ High voltage
Status	Addressed
Status Comment	The subject of this requirement is already covered by standards 6469-1, 6469-3 and EN61851 which are addressed by requirements 4SG#0007, 4SG#0009 and 4SG#0016.
Type	«Non-Function»
Priority	High
Description	The project shall cover the design phase including high voltage aspects: cable insulation, insulation monitoring, grounding concepts, component specs., access to HV points, labeling, color coding, operating procedures, risk in case of accident, relevant standards. This requirement partially overlaps EV safety standards requirements.
Derived from	• 4SG#0005: EV-specific issues • High voltage

4SG#0028: Battery	
Alias	EV-specific issues/ Battery
Status	Addressed
Status Comment	As far as relevant for MAENAD, the subject of this requirement is covered by standards 6469-3, J2344 and J2289 which are addressed by requirements 4SG#0009, 4SG#0013 and 4SG#0018. As regards SOC detection and risk of fire/explosion, especially of lithium batteries, this subject is more related to specific applications and is not addressed by the project.

Type	«Non-Function»
Priority	Medium
Description	The project shall cover the design phase including lithium battery aspects: battery management, SOC detection, risk of fire/explosion.
Derived from	• 4SG#0005: EV-specific issues

4SG#0029: Energy management	
Alias	EV-specific issues/ Energy management
Status	Addressed
Status Comment	As far as relevant for MAENAD, the subject of this requirement is covered by standards J2289 and FMVSS No. 135 which are addressed by requirements 4SG#0018 and 4SG#0071.
Type	«Non-Function»
Priority	High
Description	The project shall cover the design phase including energy management aspects: dependency with battery management and regenerative braking, HVAC, SOC, HMI, graceful performance degradation, battery charging, reverse power flow.
Derived from	• 4SG#0005: EV-specific issues • Energy management

4SG#0030: Braking	
Alias	EV-specific issues/ Braking
Status	Addressed
Status Comment	As far as relevant for MAENAD, the subject of this requirement is covered by standards J2289 and FMVSS No. 135 which are addressed by requirements 4SG#0018 and 4SG#0071.
Type	«Non-Function»
Priority	Medium
Description	The project shall cover the design phase including braking: regenerative braking, dependency with battery management and SOC, integration with hydraulic braking.
Derived from	• 4SG#0005: EV-specific issues • Braking

4SG#0031: Charging	
Alias	EV-specific issues/ Charging
Status	Addressed
Status Comment	The subject of this requirement is almost completely covered by standards ISO 6469-1, ISO 6469-2, ISO 6469-3, J2344, EN 61851, J2289, ISO 15118, J2836, J2847 and J1277 which are addressed by requirements 4SG#0007, 4SG#0008, 4SG#0009, 4SG#0013, 4SG#0016, 4SG#0018, 4SG#0024, 4SG#0025, 4SG#0026 and 4SG#0074. Contents regarding communication are addressed as design activity of FEV development process (FEV swimlane of MAENAD methodology). See requirement 4SG#0024.
Type	«Non-Function»
Priority	High
Description	The project shall cover the design phase including charging: dependency with energy management and parking, HMI, operating procedures, vehicle grounding, communication, charging systems, billing, reverse power flow. This requirement partially overlaps

	safety and communication requirements.
Derived from	• 4SG#0005: EV-specific issues • Charging

4SG#0032: Parking	
Alias	EV-specific issues/ Parking
Status	Addressed
Status Comment	The subject of this requirement is almost completely covered by standards ISO 6469-2, J2289, FMVSS No. 114 and FMVSS No. 102 which are addressed by requirements 4SG#0008, 4SG#0018, 4SG#0072 and 4SG#0073.
Type	«Non-Function»
Priority	Medium
Description	The project shall cover the design phase including parking function: design of stop device, device operation, dependency with charging, HMI. This requirement partially overlaps safety and communication requirements.
Derived from	• 4SG#0005: EV-specific issues • Parking

4SG#0033: Integration with auxiliaries	
Alias	EV-specific issues/ Integration with auxiliaries
Status	Addressed
Status Comment	Addressed as design activity of FEV development process (FEV swimlane of MAENAD methodology). EAST-ADL and simulation tools cover system interface description and analysis, including data flow, power supply and energy exchange.
Type	«Non-Function»
Priority	High
Description	The project shall cover the design phase including interfacing with auxiliaries: power steering, braking system, pumps management.
Derived from	• 4SG#0005: EV-specific issues • Integration with auxiliaries

4SG#0039: Variability of EV architectures	
Alias	EV-specific issues/ Variability of EV architectures
Status	Addressed
Status Comment	EAST-ADL and MAENAD tools support variability issues.
Type	«Variability»
Priority	High
Description	Cover the design phase including the different options in terms of propulsion architectures and technologies (e.g. single motor, wheel motors, electronic differential, PM motors, etc.).
Derived from	• 4SG#0005: EV-specific issues

4SG#0040: Hazard analysis and risk assessment	
Alias	ISO 26262-3/ Hazard analysis and risk assessment
Status	Addressed

Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall cover the design phase including the risk assessment activity according to ISO 26262.
Derived from	• ISO 26262 • DOW#0009 O1-1 • 4SG#0052: ISO 26262-3 Concept phase
Refined by	• 4SG#0041 … 4SG#0045

4SG#0041: Risk assessment data structure	
Alias	Hazard analysis and risk assessment/ Risk assessment data structure
Status	Addressed
Status Comment	EAST-ADL includes the data structure that enables risk assessment.
Type	«Concept»
Priority	High
Description	The project shall define a data structure to manage the data requested to perform risk assessment.
Derived from	• 4SG#0040: Hazard analysis and risk assessment

4SG#0042: Scenario definition	
Alias	Hazard analysis and risk assessment/ Scenario definition
Status	Addressed
Status Comment	EAST-ADL includes the data structure that enables scenario definition.
Type	«Safety»
Priority	High
Description	The project shall enable the situation analysis by the intelligent combination of environmental conditions and vehicle operations.
Derived from	• 4SG#0040: Hazard analysis and risk assessment

4SG#0043: Reduction of hazardous events	
Alias	Hazard analysis and risk assessment/ Reduction of hazardous events
Status	Addressed
Status Comment	Reduction of hazardous events is feasible with manual operation, on the basis of data structure.
Type	«Safety»
Priority	High
Description	The project shall support the reduction of the list of hazardous events by means of controllability and severity criteria.
Derived from	• 4SG#0040: Hazard analysis and risk assessment

4SG#0044: Aggregation of safety goals

Alias	Hazard analysis and risk assessment/ Aggregation of safety goals
Status	Addressed
Status Comment	Aggregation of safety goals is feasible with manual operation, on the basis of data structure.
Type	«Safety»
Priority	High
Description	The project shall enable the assignment of ASILs according to ISO 26262 tables.
Derived from	• 4SG#0040: Hazard analysis and risk assessment

4SG#0045: ASIL assignment	
Alias	Hazard analysis and risk assessment/ ASIL assignment
Status	Addressed
Status Comment	EAST-ADL modeling supports ASIL assignment to hazardous events and to architecture elements.
Type	«Safety»
Priority	High
Description	Enable the assignment of ASILs according to ISO 26262 tables.
Derived from	• 4SG#0040: Hazard analysis and risk assessment

4SG#0046: ISO26262-9 - ASIL decomposition	
Alias	ISO 26262-9/ ASIL decomposition
Status	Addressed
Status Comment	Fully addressed by EAST-ADL language support and tool support via HiP-HOPS.
Type	«Safety»
Priority	Medium
Description	The project shall support the ASILs decomposition according to ISO 26262-9 rules.
Derived from	• DOW#0009 O1-1 • ISO 26262

4SG#0047: ISO 26262-4 Development at system level	
Alias	ISO 26262-4
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”. Note: This requirement derives from some discussions about EAST-ADL. It was agreed that EAST-ADL2 shall support part 3 (Concept phase) and part 4 (System design), limited to the descending phases of V cycle.
Type	«Safety»
Priority	Medium
Description	The project shall support the development at system level according to ISO 26262-4.
Derived from	• ISO 26262 • DOW#0009 O1-1
Refined by	• 4SG#0055 … 4SG#0056

4SG#0049a Definition of testing	
Alias	Definition of testing
Status	Addressed
Status Comment	Addressed as activity of MAENAD methodology. See 4SG#0049b. Note: Since the ISO 26262 requires that provisions for testing shall be defined during the design phase, and EAST-ADL2 should cover the design phase, this requirement is a consequence.
Type	«Safety»
Priority	Medium
Description	The methodology shall support the definition of the testing during system design and integration. In particular, the project shall support the definition of test cases according to the required methods to derive test cases: • To enable the definition of equivalence classes • To enable the definition of boundary values Comment: The idea is to identify in one of the suitable representation of the system (e.g. parametric diagram) the variables and some associated attributes (e.g. equivalence classes) in order to give useful inputs to define and perform testing.
Derived from	• 4SG#0068

4SG#0052: ISO 26262-3 Concept phase	
Alias	ISO 26262-3 Concept phase
Status	Addressed
Status Comment	MAENAD methodology includes ISO26262 concept phase activities and related work products.
Type	«Safety»
Priority	Medium
Description	The methodology shall cover ISO 26262 part 3 - Concept phase. The concept phase is composed of: - Item definition - Initiation of safety lifecycle - Hazard analysis and risk assessment - Functional safety concept
Derived from	• DOW#0009 O1-1
Refined by	• 4SG#0040, 4SG#0053, 4SG#0054

4SG#0053: ISO 26262-4 Functional safety requirements	
Alias	ISO 26262-4 Functional safety requirements
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	High
Description	The project shall support the definition and verification of the functional safety

	requirements.
Derived from	• 4SG#0052: ISO 26262-3 Concept phase
Refined by	• 4SG#0057 … 4SG#0060, 4SG#0048

4SG#0055: ISO 26262-4 Technical safety requirements	
Alias	ISO 26262-4 Technical safety requirements
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	Medium
Description	The project shall support the definition and verification of the technical safety requirements.
Derived from	• 4SG#0047: ISO 26262-4 Development at system level
Refined by	• 4SG#0063 … 4SG#0065, 4SG#0048

4SG#0059 Activities to define functional safety requirements	
Alias	Activities to define functional safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes ISO26262 concept phase activities and related work products.
Type	«Safety»
Priority	Medium
Description	The design methodology shall include the required activities to define and verify the functional safety requirements. **Design activities** • Safety requirements allocation • Failure mode description • System simulation in the case of failures • Safety analyses (qualitative)
Derived from	• 4SG#0053: ISO 26262-4 Functional safety requirements

4SG#0062 Activities to define functional safety concept	
Alias	Activities to define functional safety concept
Status	Addressed
Status Comment	MAENAD methodology includes ISO26262 concept phase activities and related work products.
Type	«Safety»
Priority	Medium
Description	The design methodology shall include the required activities to define the functional safety concept. **Design activities** • Functional partitioning • Physical partitioning • Function definition • Physical architecture definition

	• ASIL decomposition • ASIL allocation • Safety analyses (qualitative)
Derived from	• 4SG#0054: ISO26262-3 Functional safety concept

4SG#0065 Activities to define technical safety requirements	
Alias	Activities to define technical safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes ISO26262 product development at system level activities and related work products.
Type	«Safety»
Priority	Medium
Description	The design methodology shall include the required activities to define and verify the technical safety requirements. **Design activities** • Diagnostics definition • Definition of prevention measures for latent faults • Definition of reaction to faults • Modeling and simulation • Safety analyses • Definition of safety mechanisms • ASIL decomposition and allocation • Physical architecture definition
Derived from	• 4SG#0055: ISO 26262-4 Technical safety requirements

4SG#0069 Enabling testing	
Alias	Enabling testing
Status	Addressed
Status Comment	Considered as design activity of MAENAD development process (safety swimlane of MAENAD methodology). For implementation details see following table:
Type	«Safety»
Priority	Medium
Description	In the design phase, the project shall enable the conduction of the tests according to the required test methods. Back-to-back test: - Simulation of test cases

Requirement detail	**Implementation status**
Simulation of test cases	Modeled using EAST-ADL execution semantics. Analyzed using simulation tool plug-ins.
Fault modeling	Modeled using EAST-ADL error propagation semantics. Analyzed using error propagation tool plug-ins.
Provisions for fault injection in design phase	Behavioral model executable by rapid prototyping equipment can be enhanced to inject faults that simulate the effects of random HW failure.
Metrics for resource usage	Modeled using GenericConstraints. Analyzed in EATOP plug-in.
Resource usage analysis	

	Fault injection test: - Fault modeling - Provisions for fault injection in the design phase Resource usage test: - Metrics for resource usage - Resource usage analysis
Derived from	• 4SG#0068 Activities to define technical safety concept

4SG#0070: R13H Braking	
Alias	R13H Braking
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	The project shall address the proposed Regulation R13H, which gives prescription for braking, including regenerative braking.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0155 … 4SG#0157

4SG#0071: FMVSS No. 135 Brake system	
Alias	FMVSS No. 135 Brake system
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	The project shall address the FMVSS No. 135, which gives prescription for braking, including regenerative braking.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0133 … 4SG#0137

4SG#0072: FMVSS No. 114 Theft protection	
Alias	FMVSS No. 114 Theft protection
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	The project shall address the FMVSS No. 114, which gives prescription for theft protection, and has impact on EV controls, such as steering and car locking.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0127 … 4SG#0129

4SG#0073: FMVSS No. 102 Transmission shift lever

Alias	FMVSS No. 102 Transmission shift lever
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	The project shall address the FMVSS No. 102, which gives prescription for theft protection, and has impact on EV controls, such as steering and car locking.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0130

4SG#0074: SAE J1277 Conductive charge coupler	
Alias	SAE J1277 Conductive charge coupler
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	This project shall address SAE J1277, which gives prescription regarding conductive charging. Specific requirements relevant to Maenad are pilot communication and charging management.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0150 … 4SG#0154

4SG#0075: R 116 Unauthorized use	
Alias	R 116 Unauthorized use
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Functional»
Priority	Medium
Description	The project shall address the regulation No. 116, which gives prescription to prevent the unauthorized use of cars, and has impact on EV controls, such car locking.
Derived from	• 4SG#0002: EV regulations
Refined by	• 4SG#0131, 4SG#0132

4SG#0078: 6469-1 - Insulation design and verification	
Alias	6469-1 - Insulation design and verification
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the insulation design and verification, in particular:

	- Deployment of insulation resistance - Addressing insulation monitoring system - Hazard analysis and risk assessment concerning insulation monitoring - Design issues concerning recharging (grounding, communication) - Test planning concerning insulation - Production, operation and maintenance requirements during design phase (ISO 26262-4).
Derived from	• 4SG#0007: ISO 6469-1

4SG#0079: 6469-1 - Prevention of danger due to heat generation	
Alias	6469-1 - Prevention of danger due to heat generation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design and verification of a monitoring system to prevent dangerous effects to persons, in the case of failures producing heat generation.
Derived from	• 4SG#0007: ISO 6469-1

4SG#0082: 6469-1 - Design of RESS interruption device	
Alias	6469-1 - Design of RESS interruption device
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the following activities: - the design and verification of an overcurrent interruption device - Hazard analysis in the case of short circuit of RESS - Planning of short circuit test.
Derived from	• 4SG#0007: ISO 6469-1

4SG#0083: 6469-2 - Connection to off board power supply	
Alias	6469-2 - Connection to off board power supply
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a means to make impossible to move the vehicle when connected to off-board electric power supply and charged by the user.
Derived from	• 4SG#0008: ISO 6469-2

4SG#0084: 6469-2 - Warning of reduced power

Alias	6469-2 - Warning of reduced power
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a warning to signal to the driver that the propulsion power is reduced, in the case this is done.
Derived from	• 4SG#0008: ISO 6469-2

4SG#0085: 6469-2 - Driving backwards	
Alias	6469-2 - Driving backwards
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of means to prevent unintentional switching in reverse when the vehicle is in motion (two options are available, see the standard).
Derived from	• 4SG#0008: ISO 6469-2

4SG#0086: 6469-2 - Parking	
Alias	6469-2 - Parking
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of - a warning to indicate whether propulsion is in the driving–enable mode, when user leaves the vehicle - a safety mechanism to prevent unexpected movements.
Derived from	• 4SG#0008: ISO 6469-2

4SG#0087: 6469-2 - Protection against failures	
Alias	6469-2 - Protection against failures
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology, and in particular the functional safety development, shall consider unintended acceleration, deceleration and reverse motion as hazards to be prevented or minimized.
Derived from	• 4SG#0008: ISO 6469-2

4SG#0088: 6469-3 - Protection of persons against electric shock	
Alias	6469-3 - Protection of persons against electric shock
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the design of mechanical and electronics means according to the standard - the verification planning for measures protection (design verification, test plan).
Derived from	• 4SG#0009: ISO 6469-3

4SG#0089: 6469-3 - Protection of persons against electric shock (alternative approach)	
Alias	6469-3 - Protection of persons against electric shock (alternative approach)
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the conduction of an appropriate hazard analysis with respect to electric shock and establish a set of measures which give sufficient protection against electric shock.
Derived from	• 4SG#0009: ISO 6469-3

4SG#0090: 6469-3 - Insulation resistance requirements	
Alias	6469-3 - Insulation resistance requirements
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the assignment of insulation resistance to high voltage components as to achieve the overall insulation resistance (dc, ac cases).
Derived from	• 4SG#0009: ISO 6469-3

4SG#0092: 6469-3 - Methodology requirements concerning potential equalization	
Alias	6469-3 - Methodology requirements concerning potential equalization
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the design of insulation barriers and bonded conductive equalization barriers - the planning verification of barriers, including bond testing.

Derived from	• 4SG#0009: ISO 6469-3

4SG#0094: 6469-3 - Methodology for the charging inlet disconnection	
Alias	6469-3 - Methodology for the charging inlet disconnection
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the design of the charge system, as to ensure voltage decrease of inlet according to time requirements. - the verification by simulation, analysis and testing.
Derived from	• 4SG#0009: ISO 6469-3

4SG#0095: 6469-3 - Grounding and insulation resistance requirement for charging inlet	
Alias	6469-3 - Grounding and insulation resistance requirement for charging inlet
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of the charging system as to meet insulation requirements in the case of ac and ac inlet.
Derived from	• 4SG#0009: ISO 6469-3

4SG#0096: EN 61851 - Types of EV connection	
Alias	EN 61851 - Types of EV connection
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include - the definition of the charging system according to one of the 4 charging modes. - the definition of the control pilot mandatory and optional functions (modes 2-4), including charging operation states.
Derived from	• 4SG#0016: EN 61851

4SG#0097: EN 61851 - Protection against electric shock	
Alias	EN 61851 - Protection against electric shock
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»

Priority	Medium
Description	The EV development methodology shall include the definition and the design of measures to prevent electric shock both in normal service and in case of fault.
Derived from	• 4SG#0016: EN 61851

4SG#0099: EN 61851 - Methodology concerning the stored energy – discharge of capacitors	
Alias	EN 61851 - Methodology concerning the stored energy – discharge of capacitors
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of the EV voltage input in such a way to control the voltage decay after EV disconnection.
Derived from	• 4SG#0016: EN 61851

4SG#0100: EN 61851 - Detection of the electrical continuity of the protective conductor	
Alias	EN 61851 - Detection of the electrical continuity of the protective conductor
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a monitoring system to detect the electrical continuity of the protective conductor during charging modes 2, 3 and 4.
Derived from	• 4SG#0016: EN 61851

4SG#0101: EN 61851 - Dielectric withstand voltage	
Alias	EN 61851 - Dielectric withstand voltage
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the design of the on board charging equipment as to withstand the test voltage at any input connection (2U +1000 V, min. 1500 V AC). - the design of all vehicle equipment as to withstand a test voltage of 4kV between AC or DC input and low voltage inputs (if any).
Derived from	• 4SG#0016: EN 61851

4SG#0102: EN 61851 - Electric vehicle insulation resistance	
Alias	EN 61851 - Electric vehicle insulation resistance
Status	Addressed

Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the verification of the insulation resistance (by analysis and testing). Minimum required: 1 MΩ.
Derived from	• 4SG#0016: EN 61851

4SG#0103: EN 61851 - Drive train interlock	
Alias	EN 61851 - Drive train interlock
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a system to detect the connection of the mobile connector or that the plug and the cable have been stored in the vehicle. The system shall also inhibit the drive train.
Derived from	• 4SG#0016: EN 61851

4SG#0104: J2289 - Vehicle operational modes	
Alias	J2289 - Vehicle operational modes
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the defining the vehicle operational modes according to those required by the standard and eventually justify the possible discrepancies.
Derived from	• 4SG#0018: J2289

4SG#0107: J2289 - Key-on discharge	
Alias	J2289 - Key-on discharge
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - Assessment of battery capability to match the vehicle demand (range, supply of auxiliary equipment) - Designing means to detect and limit the overdischarge of individual cells - Providing fault protection devices (fuses, fast contactors).
Derived from	• 4SG#0018: J2289

4SG#0110: J2289 - Key-on Regen operation

Alias	J2289 - Key-on Regen operation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the assessment of the compliance of the voltage with the limits during regeneration - the design of means to avoid drive component overvoltage occurrence during regeneration - the verification of the compliance with current and voltage profiles - design means to limit battery current and voltage during regeneration according to the specified profiles.
Derived from	• 4SG#0018: J2289

4SG#0113: J2289 - Key-on charge	
Alias	J2289 - Key-on charge
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the verification that all charge system components match w.r.t. electrical characteristics - the design of the charge algorithm to be performed with the battery supplier.
Derived from	• 4SG#0018: J2289

4SG#0116: J2289 - Key-Off Parked Off Plug Operating	
Alias	J2289 - Key-Off Parked Off Plug Operating
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include: - the realization the energy management to prevent excessive discharge due to vehicle equipment operating in key-off mode - the verification of the energy behavior in key-off mode by simulation/calculation - the design of charge algorithm with the battery supplier.
Derived from	• 4SG#0018: J2289

4SG#0118: J2289 - Parked Off Plug IDLE/Storage Operation	
Alias	J2289 - Parked Off Plug IDLE/Storage Operation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»

Priority	Medium
Description	The EV development methodology shall include: - the design of the contactor operation as to be deactivated in the case of crash or insulation fault - the design of the disconnect system for added safety during service or by first responders.
Derived from	• 4SG#0018: J2289

4SG#0121: J2289 - Discharge management - Performance limits	
Alias	J2289 - Discharge management - Performance limits
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of the BMS to protect for overtemperature, under-temperature, over-current.
Derived from	• 4SG#0018: J2289

4SG#0122: J2289 - Charge management	
Alias	J2289 - Charge management
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of communication in compliance with SAE J1772, SAE J1773, and SAE J2293.
Derived from	• 4SG#0018: J2289

4SG#0124: J2289 - Key-on startup diagnostics and warning	
Alias	J2289 - Key-on startup diagnostics and warning
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of key-on running diagnostics and warning procedures.
Derived from	• 4SG#0018: J2289

4SG#0125: J2289 - Service diagnostics	
Alias	J2289 - Service diagnostics
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).

Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of service diagnostics.
Derived from	• 4SG#0018: J2289

4SG#0126: J2289 - Toxic emissions - Flammable gasses	
Alias	J2289 - Toxic emissions - Flammable gasses
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall consider toxic emissions and flammable gasses caused by battery damages.
Derived from	• 4SG#0018: J2289

4SG#0128: FMVSS No. 114 - Design of keylocking device	
Alias	FMVSS No. 114 - Design of keylocking device
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of a keylocking system to prevent the activation of the motor and steering or selfmobility (or both).
Derived from	• 4SG#0072: FMVSS No. 114 Theft protection

4SG#0129: FMVSS No. 114 - Operation and performance of keylocking device	
Alias	FMVSS No. 114 - Operation and performance of keylocking device
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include: - the design of the operation of keylocking system according to the standard (see interaction with park command). - the verification (by calculation and testing) that the maximum movement of the vehicle when locked is less than the max. allowable limit.
Derived from	• 4SG#0072: FMVSS No. 114 Theft protection

4SG#0130: FMVSS No. 102 Transmission shift lever design	
Alias	FMVSS No. 102 Transmission shift lever design
Status	Addressed

Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of the shift lever according to the sequence position and rotation requirements given by the regulation.
Derived from	• 4SG#0073: FMVSS No. 102 Transmission shift lever

4SG#0131: R 116 Unauthorized use – Design of locking device	
Alias	R 116 Unauthorized use – Design of locking device
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of devices to prevent unauthorized use (deactivation of engine in combination with a system to lock other vehicle functions, see regulation).
Derived from	• 4SG#0075: R 116 Unauthorized use

4SG#0132: R 116 Unauthorized use – Functional safety analysis of locking device	
Alias	R 116 Unauthorized use – Functional safety analysis of locking device
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the conduction of functional safety analyses to cover the devices intended to prevents unauthorized use.
Derived from	• 4SG#0075: R 116 Unauthorized use

4SG#0133: FMVSS No. 135 Regenerative brake system	
Alias	FMVSS No. 135 Regenerative brake system
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include: - the development of braking system according to the operation mode of the RBS: control of RBS by ABS (if RBS is always active, also in neutral without any means to disconnect it by the driver, RBS is part of the service braking system); - item definition: consider the interactions between RBS and ABS (w.r.t. interfacing and system definition in ISO 26262).
Derived from	• 4SG#0071: FMVSS No. 135 Brake system

4SG#0135: FMVSS No. 135 Design of diagnostics and warning system of brake system

Alias	FMVSS No. 135 Design of diagnostics and warning system of brake system
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include: - diagnostics task related to RBS, in order to transmit information to the visual warning indicator - design of proper warning in the case of failure of brake power supply, reduced SoC, RBS failure.
Derived from	• 4SG#0071: FMVSS No. 135 Brake system

4SG#0137: FMVSS No. 135 Testing of brake system performance in depleted SOC battery	
Alias	FMVSS No. 135 Testing of brake system performance in depleted SOC battery
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the braking test in depleted battery state-of-charge condition.
Derived from	• 4SG#0071: FMVSS No. 135 Brake system

4SG#0141: ISO 8715 - Performance testing - Testing activity	
Alias	ISO 8715 - Performance testing - Testing activity
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the vehicle performance testing according to test condition and test procedure requirements.
Derived from	• 4SG#0019: ISO 8715

4SG#0145: ISO 8714 - Energy and range testing - Simulation of energy and range performance	
Alias	ISO 8714 - Energy and range testing - Simulation of performance
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the simulation of vehicle performance according to test conditions and test procedure requirements.
Derived from	• 4SG#0020: ISO 8714

4SG#0148: ISO 12045-2 - Lithium batteries - Simulation according to test condition requirements	
Alias	ISO 12045-2 - Lithium batteries - Simulation according to test condition requirements
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the simulation of vehicle performance according to test conditions requirements (when applicable).
Derived from	• 4SG#0023: ISO 12405-2

4SG#0150: SAE J1277 Conductive charge coupler - Control pilot modeling	
Alias	SAE J1277 Conductive charge coupler - Control pilot modeling
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	Model communication protocol based on PWM and signal amplitude (by switching a resistor).
Derived from	• 4SG#0074: SAE J1277 Conductive charge coupler

4SG#0151: SAE J1277 Conductive charge coupler - Communication design	
Alias	SAE J1277 Conductive charge coupler - Communication design
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of the communication according to the standard (charging station status, power level, fault conditions).
Derived from	• 4SG#0074: SAE J1277 Conductive charge coupler

4SG#0152: SAE J1277 Conductive charge coupler - Management of connector signals	
Alias	SAE J1277 Conductive charge coupler - Management of connector signals
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of the management of the connector detection signal: to start charge control, to engage drive train interlock, to reduce charge load during disconnection.

Derived from	• 4SG#0074: SAE J1277 Conductive charge coupler

4SG#0153: SAE J1277 Conductive charge coupler - Design of charging state machine	
Alias	SAE J1277 Conductive charge coupler - Design of charging state machine
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the design of the charging state machine according to the standard, including safe states in case of fault.
Derived from	• 4SG#0074: SAE J1277 Conductive charge coupler

4SG#0154: SAE J1277 Conductive charge coupler - Design charge indicators and diagnostics	
Alias	SAE J1277 Conductive charge coupler - Design charge indicators and diagnostics
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the definition of the charge status indicator, including diagnostic functions.
Derived from	• 4SG#0074: SAE J1277 Conductive charge coupler

4SG#0156: R13H Braking - Design of braking compensation transients	
Alias	R13H Braking - Design of braking compensation transients
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	If the RBS is part of service brake, the EV development methodology shall include the design of the braking inputs, compensating the variations of the regenerative braking and ensuring breaking action in all wheels.
Derived from	• 4SG#0070: R13H Braking

4SG#0157: R13H Braking - Design interaction between ABS and RBS	
Alias	R13H Braking - Design interaction between ABS and RBS
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Functional»
Priority	Medium
Description	The EV development methodology shall include the development task to define and

	manage the interaction between ABS and RBS.
Derived from	• 4SG#0070: R13H Braking

4SG#0160: J2344 - Electric insulation	
Alias	J2344 - Electric insulation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include activities to: - Design the high voltage insulation (100 ohm/V DC, 500 ohm/V AC) - Design barriers between AC and DC, if the DC limit is applied - Plan testing to demonstrate high voltage withstand capability - Design an insulation loss monitoring system.
Derived from	• 4SG#0013: J2344

4SG#0161: J2344 - High Voltage Automatic Disconnect System	
Alias	J2344 - High Voltage Automatic Disconnect System
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include activities to: • Design an automatic disconnect system actuated - by a crash sensor - in the case of loss of insulation, only in non-motoring mode - in the case of overcurrent condition, as a primary or secondary protection - according to the guidelines given by SAE J2344 • Design a crash sensor, properly qualified to operate in the crash tests. • Design the disconnect system to be activated by the crash sensor and to maintain disconnection after crash.
Derived from	• 4SG#0013: J2344

4SG#0162: J2344 - High Voltage Manual Disconnect System	
Alias	J2344 - High Voltage Manual Disconnect System
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a manual disconnect system actuated by an interlock loop.
Derived from	• 4SG#0013: J2344

4SG#0163: J2344 - Grounding

Alias	J2344 - Grounding
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of the grounding of the conductive cases containing high voltage systems, also by means of indirect connection.
Derived from	• 4SG#0013: J2344

4SG#0164: J2344 - Fault monitoring	
Alias	J2344 - Fault monitoring
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of - a fault monitoring system - the vehicle operation in such a way that the vehicle operator is not allowed to persist in unsafe condition.
Derived from	• 4SG#0013: J2344

4SG#0165: J2344 - Rechargeable Energy Storage System State-of-Charge	
Alias	J2344 - Rechargeable Energy Storage System State-of-Charge
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of the operation in low state-of-charge in such a way that - the performance of the critical safety systems is not degraded - the state is indicated in a separate indicator if the vehicle performance is reduced.
Derived from	• 4SG#0013: J2344

4SG#0166: J2344 - Mechanical safety	
Alias	J2344 - Mechanical safety
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	Medium
Description	The EV development methodology shall include the design of a lock system activated when the shift mechanism is in P position or the key is in “off” position.
Derived from	• 4SG#0013: J2344

CRF#0001 UNECE R100	
Alias	EV Safety / UNECE R100
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	UNECE Regulation No. 100 - Battery electric vehicles with regard to specific requirements for construction and functional safety (series 01).
Derived from	

CRF#0002 R94 new EV proposals	
Alias	EV Safety / R94 new EV proposals
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	Proposal for the 02 series of amendments to Regulation No. 94 (Frontal collision protection).
Derived from	

CRF#0003 R95 new EV proposals	
Alias	EV Safety / R95 new EV proposals
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	Proposal for the 03 series of amendments to Regulation No. 95 (Lateral collision protection).
Derived from	

CRF#0004a Insulation	
Alias	ISO 6469-1 and UNECE R100 / Insulation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the insulation resistance of the RESS (Rechargeable energy storage system). For a RESS not embedded in a whole circuit, the minimum requirement for the insulation resistance Ri divided by its maximum working voltage shall be 100 Ω/V, if not containing AC, or 500 Ω/V, if containing AC without additional AC protection throughout the entire lifetime of the

	RESS. When the RESS is integrated in a whole electric circuit, a higher resistance value for the RESS may be necessary. The measurement shall be done following the recommended procedure after a preconditioning and conditioning period.
Derived from	

CRF#0005a Creepage and clearance distance	
Alias	ISO 6469-1 / Creepage and clearance distance
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements on clearance and creepage distance between RESS terminals. a) In the case of a creepage distance between two RESS connection terminals: d W 0,25U + 5 b) In the case of a creepage distance between live parts and the electric chassis: d W 0,125U + 5 where d is the creepage distance between the live part and the electric chassis, in millimeters (mm); U is the maximum working voltage between the two RESS connection terminals, in volts (V). The clearance between conductive surfaces shall be 2,5 mm minimum.
Derived from	

CRF#0006a Heat generation	
Alias	ISO 6469-1 and UNECE R100 / Heat generation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account heat generation by the RESS under first-failure conditions. Heat generation under any first-failure condition, which could form a hazard to persons, shall be prevented by appropriate measures, e.g. based on monitoring of current, voltage or temperature.
Derived from	

CRF#0007a Gases emission	
Alias	ISO 6469-1 and UNECE R100 / Gases emission
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High

Description	The EAST-ADL approach shall take into account emission of hazardous gases by the RESS. No potentially dangerous concentration of hazardous gases and other hazardous substances shall be allowed anywhere in the driver, passenger and load compartments. Refer to the latest version of applicable National/International Standards or regulations for the maximum allowed accumulated quantity of hazardous gases and other substances. Appropriate countermeasures shall manage first-failure situations.
Derived from	

CRF#0008a RESS over-current interruption	
Alias	ISO 6469-1 / RESS over-current interruption
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the interruption of RESS over-current. If a RESS system is not short-circuit proof in itself, a RESS over-current interruption device shall open the RESS circuit under conditions specified by the vehicle and/or RESS manufacturer.
Derived from	

CRF#0009a Crash-test requirements	
Alias	ISO 6469-1 / Crash-test requirements
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account specific RESS crash-test requirements. The following requirements shall be met in a crash test, in accordance with the test requirements of applicable National and/or International Standards or regulations or standards: a) If the RESS is located outside the passenger compartment, it shall not penetrate into the passenger compartment. b) If the RESS is located inside the passenger compartment, movement of the RESS shall be limited to ensure the safety of the occupants. c) No spilled electrolyte shall enter the passenger compartment during and after the test.
Derived from	

CRF#0010a Power-on procedure	
Alias	ISO 6469-2 / Power-on procedure
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).

Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements on power-on/power off procedure. At least two deliberate, distinct actions shall be performed in order to go from the "power-off" mode to the "driving enabled" mode. a) Power-off: the propulsion system is off; no active driving of the vehicle is possible in this mode. b) Driving enabled: only in this mode will the vehicle move when the accelerator device is applied. After an automatic or manual turn-off of the propulsion system, it shall only be possible to reactivate the system by the specified power-on procedure.
Derived from	

CRF#0011a Propulsion system status indication	
Alias	ISO 6469-2 / Propulsion system status indication
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the indication of the propulsion system status. An obvious device (e.g. a visual or audible signal) shall indicate permanently or temporarily that the propulsion system is ready for driving.
Derived from	

CRF#0012a Connection to power supply	
Alias	ISO 6469-2 / Connection to power supply
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the connection of the vehicle to an off-board electric power supply. Vehicle movement by its own propulsion system shall be impossible when the vehicle is physically connected to an external electrical network (e.g. mains, off-board charger).
Derived from	

CRF#0013a RESS state indications	
Alias	ISO 6469-2 / RESS state indications
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the indication of reduced power and low energy content of RESS. If the power is automatically reduced to

	a significant extent (e.g. by high temperature of the power unit or of the energy source component), this shall be indicated to the driver by an obvious device such as a visual or audible signal. A low state of charge of the traction battery shall be indicated to the driver by an obvious device. At the indicated low state of charge specified by the vehicle manufacturer, the vehicle shall meet the following requirements: a) It shall be possible to move the vehicle out of the traffic area by its own propulsion system. b) A minimum energy reserve shall still be available for the lighting system as required by national and/or international standards or regulations, when there is no independent energy storage for the auxiliary electrical circuit.
Derived from	

CRF#0014a Driving backward	
Alias	ISO 6469-2 / Driving backward
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for driving backward. If driving backwards is achieved by reversing the rotational direction of the electric motor, the following requirements shall be met to prevent unintentional switching into reverse when the vehicle is in motion: a) switching between the forward and backward (reverse) directions shall require either two separate actions by the driver, or b) if only one driver action is required, a safety device shall allow the transition only when the vehicle is stationary or moving slowly. The maximum reverse speed shall be limited.
Derived from	

CRF#0015a Parking	
Alias	ISO 6469-2 / Parking
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for parking. When leaving the vehicle, the driver shall be informed by an obvious device (e.g. a visual or audible signal) if the propulsion system is still in the driving enabled mode. If the electric motor continues to rotate when the vehicle is stationary, no unintended movement of the vehicle shall be possible after switching to the power-off mode.
Derived from	

CRF#0016a Electromagnetic compatibility	
Alias	ISO 11451-2 / Electromagnetic compatibility

Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for electromagnetic susceptibility and emissions. The electric road vehicle shall be tested for susceptibility according to ISO 11451-2. The reference field strength shall be a minimum of 30 V/m rms or according to national standards or regulations. Care shall be taken to minimize electromagnetic emissions from the electric road vehicle, taking into account national standards or regulations and international standards. Vehicle functions enabled by the auxiliary circuits shall meet the relevant national and/or international standards or regulations during operation of the vehicle, particularly those related to lighting, signaling and safety functions.
Derived from	

CRF#0017a Protection against failure	
Alias	ISO 6469-2 / Protection against failure
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for fail-safe design, first failure response and unintentional vehicle behavior. Unintentional acceleration, deceleration and reversal of the propulsion system shall be prevented. In the event of a single failure (e.g. in the power control unit) of a stationary, unbraked vehicle, the propulsion shall be cut off to prevent unintended vehicle movement. Unintended steering effects from different torques while driving or braking that are greater than those of IC enginepropelled vehicles shall not occur.
Derived from	

CRF#0018a Emergency response	
Alias	ISO 6469-2 / Emergency response
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for emergency response. The manufacturer of the vehicle shall have information available for safety personnel and/or emergency responders with regard to dealing with accidents involving a vehicle.
Derived from	

CRF#0019a Marking	
Alias	ISO 6469-3 and UNECE R100 / Marking

Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for marking high voltage components and high voltage wiring. The outer covering of cables and harness for high voltage circuits, not within enclosures or behind barriers shall be marked with orange color.
Derived from	

CRF#0020a Protection against electric shock	
Alias	ISO 6469-3 and UNECE R100 / Protection against electric shock
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for basic protection measures and protection under first-failure conditions against electric shock.
Derived from	

CRF#0021a Insulation	
Alias	ISO 6469-3 / Insulation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for insulation of high voltage live parts. If protection is provided by insulation, the live parts of the electric system shall be totally encapsulated by insulation which can be removed only by destruction. The insulating material shall be suitable to the maximum working voltage and temperature ratings of the vehicle and its systems. The insulation shall have sufficient withstand voltage capability.
Derived from	

CRF#0022a Barriers and enclosures	
Alias	ISO 6469-3 / Barriers and enclosures
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for barriers and enclo-

	sures to prevent electrical shock. If protection is provided by barriers/enclosures, live parts shall be placed inside enclosures or behind barriers, preventing access to the live parts from any usual direction of access. The barriers/enclosures shall provide sufficient mechanical resistance under normal operating conditions, as specified by the manufacturer. If barriers/enclosures are accessible directly they shall be opened or removed only by use of tools or maintenance keys or they shall have means to deactivate live parts with high voltage, e.g. interlock.
Derived from	

CRF#0023a Insulation resistance	
Alias	ISO 6469-3 and UNECE R100 / Insulation resistance
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the insulation resistance of the high voltage systems. If the protection measures chosen (see 7.3) require a minimum insulation resistance, it shall be at least 100 Ω/V for DC circuits and at least 500 Ω/V for AC circuits. The reference shall be the maximum working voltage.
Derived from	

CRF#0024a Withstand voltage	
Alias	ISO 6469-3 / Withstand voltage
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for withstand voltage capability of the high voltage components and wiring. The high voltage components and wiring shall fulfill the applicable sections of IEC 60664-1 or meet the withstand voltage capability according to the withstand voltage test described.
Derived from	

CRF#0025a Potential equalization	
Alias	ISO 6469-3 and UNECE R100 / Potential equalization
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for components and path for the potential equalization. All components forming the potential equalization current path (conductors, connections) shall withstand the maximum first failure current in a maximum fault clearance time. The resistance of the potential equalization path between any two exposed conductive parts of the high voltage electric circuit which can be touched simultaneously by a person shall not exceed 0.1 Ohm.
Derived from	

CRF#0026a Charging inlet	
Alias	ISO 6469-3 and UNECE R100 / Charging inlet
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the vehicle charging inlet. One second after having disconnected the charge coupler, the voltage of the vehicle inlet shall be less than or equal to 30 V AC or 60 V DC. This condition is not necessary if vehicle inlet complies with the requirement of at least IPXXB.
Derived from	

CRF#0027a Insulation resistance test	
Alias	ISO 6469-3 and UNECE R100/ Insulation resistance test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedures for the insulation resistance test.
Derived from	

CRF#0028a Withstand voltage test	
Alias	ISO 6469-3 / Withstand voltage test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedures for withstand voltage capability test.
Derived from	

CRF#0029a Potential equalization test	
Alias	ISO 6469-3 / Potential equalization test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for the potential equalization components and path test.

Derived from	

CRF#0030a Protection against electric shock after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Protection against electric shock after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for protection of persons against electric shock after vehicle crash test.
Derived from	

CRF#0031a Electrolyte spillage after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Electrolyte spillage after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for electrolyte spillage after vehicle crash test.
Derived from	

CRF#0032a RESS retention after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / RESS retention after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for RESS retention after vehicle crash test.
Derived from	

CRF#0033a Test for protection against electric shock after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Test for protection against electric shock after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for protection against electric shock test after vehicle crash test.

Derived from	

CRF#0034a Test for electrolyte spillage after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Test for electrolyte spillage after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for electrolyte spillage test after vehicle crash test.
Derived from	

CRF#0035a test for RESS retention after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / test for RESS retention after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Non-Function»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for RESS retention test after vehicle crash test.
Derived from	

CRF#0044 ISO 26262 compliance	
Alias	Methodology / ISO 26262 compliance
Status	Addressed
Status Comment	MAENAD Methodology includes requirements of part 3 and 4 of ISO 26262.
Type	«Safety»
Priority	High
Description	The MAENAD methodology shall be compliant with ISO 26262.
Derived from	

CRF#0046a SEooC	
Alias	ISO 26262 / SEooC
Status	Addressed
Status Comment	EAST-ADL supports SEooC approach.
Type	«Safety»
Priority	High
Description	Maenad approach shall support the ISO 26262 SEooC concept.
Derived from	

CRF#0047a hazard analysis and risk assessment	
Alias	ISO 26262 - 3 / hazard analysis and risk assessment
Status	Addressed
Status Comment	MAENAD methodology includes the hazard analysis and risk assessment. Moreover, EAST-ADL includes the concepts necessary to describe this kind of analysis.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 hazard analysis and risk assessment.
Derived from	

CRF#0048a ASIL determination	
Alias	ISO 26262 - 3 / ASIL determination
Status	Addressed
Status Comment	MAENAD methodology includes the ASIL determination. Moreover, EAST-ADL includes the concepts necessary to describe this kind of analysis.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 ASIL determination.
Derived from	

CRF#0049a Safety Goal	
Alias	ISO 26262 - 3 / Safety Goal
Status	Addressed
Status Comment	MAENAD methodology includes the Safety Goal definition. Moreover, EAST-ADL includes the concepts necessary to define safety goal in the model.
Type	«Safety»
Priority	High
Description	Maenad approach shall support Safety Goal and safe state definition.
Derived from	

CRF#0050a External measures	
Alias	ISO 26262 - 3 / External measures
Status	Addressed
Status Comment	MAENAD methodology includes the external measures definition. Moreover, EAST-ADL supports external measures modeling.
Type	«Safety»
Priority	High
Description	Maenad approach shall support external measures definition.
Derived from	

CRF#0051a functional safety requirements	
Alias	ISO 26262 - 3 / functional safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes the functional safety requirements definition. Moreover, EAST-ADL supports the modeling of the safety requirements.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 functional safety requirements definition, including all necessary parameters (Operating modes, fault tolerant time interval, eventually safe state, emergency operation interval, functional redundancies).
Derived from	

CRF#0052a functional safety requirements allocation	
Alias	ISO 26262 - 3 / functional safety requirements allocation
Status	Addressed
Status Comment	MAENAD methodology includes these activities. Moreover, HiP-HOPS can support this part of the safety activity.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 functional safety requirements allocation.
Derived from	

CRF#0053a technical safety requirements	
Alias	ISO 26262 - 4 / technical safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes the technical safety requirements definition. Moreover, EAST-ADL supports the modeling of the safety requirements.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 technical safety requirements definition.
Derived from	

CRF#0054a safety mechanism	
Alias	ISO 26262 - 4 / safety mechanism
Status	Addressed
Status Comment	MAENAD methodology includes the safety mechanism definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 safety mechanism definition.
Derived from	

CRF#0055a latent faults	
Alias	ISO 26262 - 4 / latent faults
Status	Addressed
Status Comment	MAENAD methodology includes the latent fault definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid latent faults.
Derived from	

CRF#0056a random HW failures	
Alias	ISO 26262 - 4 / random HW failures
Status	Addressed
Status Comment	MAENAD methodology includes the random fault definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid random HW faults.
Derived from	

CRF#0057a systematic failures	
Alias	ISO 26262 - 4 / systematic failures
Status	Addressed
Status Comment	MAENAD methodology includes the systematic fault definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid systematic faults.
Derived from	

CRF#0058a ASIL Decomposition	
Alias	ISO 26262 - 9 / ASIL Decomposition
Status	Addressed
Status Comment	Automatic ASIL decomposition has been achieved and is being further refined.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ASIL decomposition.
Derived from	

CRF#0059a Safety case

Alias	ISO 26262 /Safety case
Status	Addressed
Status Comment	MAENAD methodology and EAST-ADL language support safety case definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support Safety case specification.
Derived from	

CRF#0060 traceability	
Alias	ISO 26262 / traceability
Status	Addressed
Status Comment	EAST-ADL supports requirements traceability, through requirements model structure.
Type	«Safety»
Priority	High
Description	The traceability of safety requirements: ASIL, Safety Goal, Safe State, safety requirement- functional & technical) for system and components and test cases shall be supported during the entire development lifecycle.
Derived from	

CRF#0061a functional safety assessment	
Alias	ISO 26262 - 2 / functional safety assessment
Status	Addressed
Status Comment	Addressed by safety swimlane in MAENAD methodology (see D2.2.1).
Type	«Safety»
Priority	High
Description	Maenad approach shall support functional safety assessment.
Derived from	

7.4 WP3 - Modeling, Analysis and Synthesis Concepts

WP3 requirements are those that consider the conceptual aspects of language and algorithms.

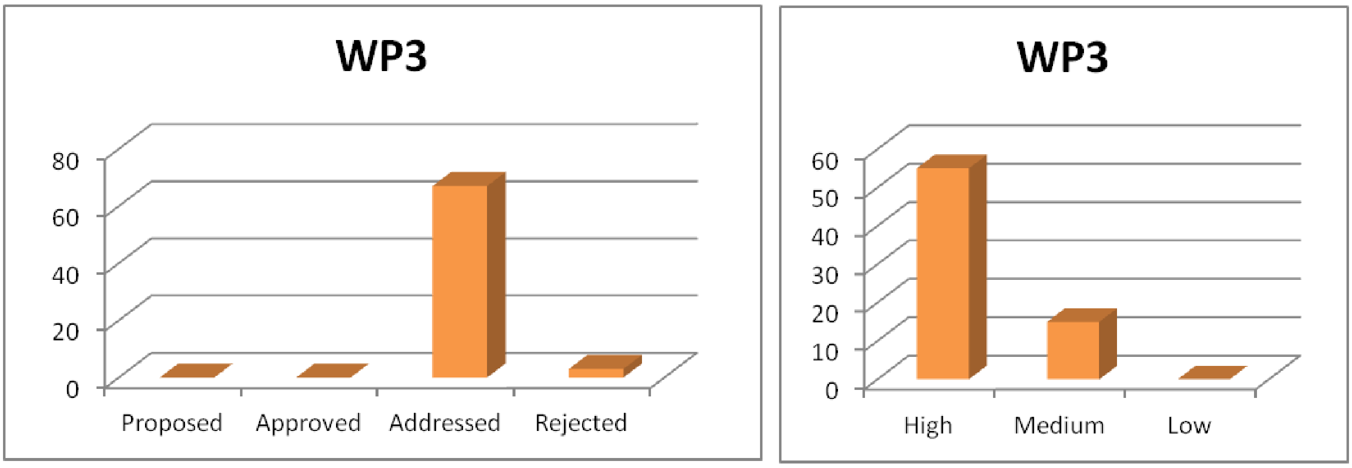


Figure 12: Status and priorities

4SG#0048 Verification of the safety requirements	
Alias	ISO 26262-4/ Verification of the safety requirements
Status	Addressed
Status Comment	Taken for grant that safety verification of the requirements (especially their correctness) requires deep analysis and examination by reviewers, it would be advantageous to know the means to support the analysis, at least as completeness formal verification addressing requirements allocation, safety goals coverage and tracking of proving activities.
Type	«Safety»
Priority	Medium
Description	Modeling shall enable easy verification of the completeness and correctness of the safety requirements, in terms of: • Completeness of the required attributes: see reqs 4SG#00057 and 4SG#0063 • Allocation of the requirements to functional and physical elements • Coverage of the safety goals • Compliance with the safety goals (capability to achieve the safety goals, possibly proved by evidence, such as simulation, prototype testing, complementary safety analyses) • Traceability
Derived from	• 4SG#0053: ISO 26262-4 Functional safety requirements • ISO 26262 • 4SG#0055: ISO 26262-4 Technical safety requirements

4SG#0049b Definition of testing	
Alias	Definition of testing
Status	Addressed
Status Comment	Addressed by MAENAD tool support. Note: The definition of equivalence classes and boundary values is one of the methods

	required by ISO 26262 to define test cases (test vectors). Maybe the method is especially useful at implementation level, as regards software testing and to define diagnostics requirements.
Type	«Safety»
Priority	Medium
Description	The language shall support the definition of the testing during system design and integration. In particular, the project shall support the definition of test cases according to the required methods to derive test cases: • To enable the definition of equivalence classes • To enable the definition of boundary values Comment: The idea is to identify in one of the suitable representation of the system (e.g. parametric diagram) the variables and some associated attributes (e.g. equivalence classes) in order to give useful inputs to define and perform testing.
Derived from	• 4SG#0068 Activities to define technical safety concept • ISO 26262

4SG#0050 Modeling for safety analyses	
Alias	ISO 26262-4/ Modeling for safety analyses
Status	Addressed
Status Comment	Failure rates are included in the Error Model and failure rate analysis should be possible via FTA, using e.g. HiP-HOPS. Markov modeling is too much to be achieved within the project.
Type	«Safety»
Priority	Medium
Description	The language shall support modeling techniques aimed at failure rate analyses (e.g. Markov modeling).
Derived from	• ISO 26262 • 4SG#0068 Activities to define technical safety concept

4SG#0051 Description of failure rate metrics	
Alias	ISO 26262-4/ Description of failure rate metrics
Status	Addressed
Status Comment	Supported by safety constraints.
Type	«Safety»
Priority	Medium
Description	The language shall support the description of element failure rate metrics, as required in the system and components developments phases.
Derived from	• ISO 26262 • 4SG#0066 Technical safety concept attributes

4SG#0054: ISO26262-3 Functional safety concept	
Alias	ISO26262-3 Functional safety concept
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.

Type	«Safety»
Priority	High
Description	The Language shall support the definition of the functional safety concept.
Derived from	• 4SG#0052: ISO 26262-3 Concept phase
Refined by	• 4SG#0058, 4SG#0061, 4SG#0062

4SG#0056: ISO 26262-4 Technical safety concept	
Alias	ISO 26262-4 Technical safety concept
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	Medium
Description	The language shall support the definition of the technical safety concept.
Derived from	• 4SG#0047: ISO 26262-4 Development at system level
Refined by	• 4SG#0066 … 4SG#0068

4SG#0058 Model characteristics aimed at the functional safety requirements	
Alias	Model characteristics aimed at the functional safety requirements
Status	Addressed
Status Comment	Addressed by using constructs from the dependability package.
Type	«Safety»
Priority	Medium
Description	The system description and modeling shall enable the definition of the safety requirements. **Modeling prerequisite:** • Listing the hazardous events • Functional description of the system operation at proper detail level (e.g. operating modes) • System operation description by means of finite state machine • Description of driver actions • Description of external measures
Derived from	• 4SG#0053: ISO 26262-4 Functional safety requirements • 4SG#0054: ISO26262-3 Functional safety concept

4SG#0060 Management of the safety requirements	
Alias	Management of the safety requirements
Status	Addressed
Status Comment	The EAST-ADL data structure enables requirement classification and their allocation to architecture elements. So requirement tracing is feasible and impact analysis (in the case of requirement changes) is enabled.
Type	«Safety»
Priority	Medium

Description	The system description and modeling shall support the management of the safety requirements. **Requirement management** • Structuring and classification • Tracing • Impact analysis
Derived from	• 4SG#0053: ISO 26262-4 Functional safety requirements

4SG#0064 Model characteristics aimed at the technical safety requirements	
Alias	Model characteristics aimed at the technical safety requirements
Status	Addressed
Status Comment	Supported by safety constraints.
Type	«Safety»
Priority	Medium
Description	The system description and modeling shall enable the definition of the technical safety requirements. **Modeling characteristics** • HMI modeling • Physical interface modeling (communication, wires, etc.) • Linking to external constraints (regulations, operational conditions, etc.) • Configuration requirements • Element fault description and classification
Derived from	• 4SG#0055: ISO 26262-4 Technical safety requirements

4SG#0066 Technical safety concept attributes	
Alias	Technical safety concept attributes
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	Medium
Description	The language shall enable the description of the technical safety concept including all required attributes. **Attributes of the technical safety requirements:** Architecture elements: • Safety requirements for each element • ASIL allocation Measures for control of random hardware failures: • Specifications of the measures to detect, control or mitigate the random failures • Target values for metrics • Evaluation procedures of violation of the safety goals • Diagnostics and coverage targets at element level **Measures to eliminate or to mitigate the effects of internal and external systematic failures:** Hardware software interface specifications: • the relevant operating modes of hardware devices and the relevant configuration

	parameters • the hardware features that ensure the independence between elements and that support software partitioning • shared and exclusive use of hardware resources • the access mechanism to hardware devices • the timing constraints defined for each service involved in the technical safety concept • the hardware diagnostic features • the diagnostic features concerning the hardware, to be implemented in software
Derived from	• 4SG#0056: ISO 26262-4 Technical safety concept
Refined by	• 4SG#0051

4SG#0067 Model characteristics aimed at the technical safety concept	
Alias	Model characteristics aimed at the technical safety concept
Status	Addressed
Status Comment	Addressed by dependability constructs.
Type	«Safety»
Priority	Medium
Description	The system description and modeling shall enable the definition of the technical safety concept. **Modeling characteristics** • Listing the random hardware, multiple and latent faults • Description of systematic faults and their effects • Metrics for diagnostics and failure rate • Precise interface definition • Provisions to enable the ability to perform tests during integration
Derived from	• 4SG#0056: ISO 26262-4 Technical safety concept

4SG#0068 Activities to define technical safety concept	
Alias	Activities to define technical safety concept
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Safety»
Priority	Medium
Description	The design methodology shall include the required activities to define the technical safety concept. **Design activities** • HW/SW partitioning • Diagnostics definition • Definition of failure mitigation measures • ASIL allocation • ASIL decomposition • Inductive and deductive safety analyses • HW & SW specification • Item integration and test planning

Derived from	• 4SG#0056: ISO 26262-4 Technical safety concept
Refined by	• 4SG#0049a, 4SG#0049b, 4SG#0050, 4SG#0069

CON#0017: Alignment EAST-ADL variability with Modelica	
Alias	Alignment EAST-ADL variability with Modelica
Status	Rejected
Status Comment	No further activities on this point were done after abandoning the simulation with Modelica.
Type	«Language»
Priority	High
Description	Align SysML variability approach with EAST-ADL variability approach. Comment: Additional requirement: Align with AUTOSAR variability approach...
Derived from	

CON#0018: Alignment EAST-ADL behavior with Modelica	
Alias	Alignment EAST-ADL behavior with Modelica
Status	Addressed
Status Comment	Initialized by investigating the mapping between EAST-ADL and Modelica meta models.
Type	«Language»
Priority	High
Description	Align EAST-ADL behavior approach with Modelica behavior approach.
Derived from	

CON#0019: Alignment EAST-ADL constraints with Modelica	
Alias	Alignment EAST-ADL constraints with Modelica
Status	Rejected
Status Comment	No further activities on this point were done after abandoning the simulation with Modelica. Also the SysML system model was replaced during the project with an AUTOSAR model. Replaced by CON#0018.
Type	«Language»
Priority	High
Description	Align EAST-ADL constraints approach with Modelica behavior approach.
Derived from	

CON#0023: Alignment EAST-ADL variability with AUTOSAR	
Alias	Alignment EAST-ADL variability with AUTOSAR
Status	Addressed
Status Comment	Feature modeling and variability concepts in EAST-ADL have been reviewed with respect to AUTOSAR compatibility (AR version 4.0.3). Feature modeling cannot be aligned because no corresponding constructs are present in AUTOSAR. Structural variability concepts in EAST-ADL closely correspond those in AUTOSAR; remaining dif-

	ferences are motivated by the structure of the EAST-ADL meta-model (e.g. separation of core and extensions).
Type	«Language»
Priority	High
Description	Align EAST-ADL variability approach with AUTOSAR variability.
Derived from	

CON#1011 Define constraints and enable verification of constraints	
Alias	Provide constraints in EAST-ADL
Status	Addressed
Status Comment	Addressed by behavioral formalization.
Type	«Validation»
Priority	High
Description	EAST-ADL has to support the formalization of constraints for model verification. In order to verify constraints, constraints must be reformulated in a language, which can be evaluated. For some constraints (application logic), even an execution and thus model behavior is required. Candidate languages for the reformulation and evaluation of constraints should be align with EAST-ADL definitions or a simulation environment as Modelica. Within the scope of the project, it has to be evaluated, if such a verification of constraints is possible and samples shall be given.
Derived from	• CON#0011 Define constraints and enable verification of constraints

CON#1012 Define time constraints and enable verification of time constraints	
Alias	Provide time constraints in EAST-ADL (TADL)
Status	Addressed
Status Comment	Timing analyses of EAST-ADL has been done with Qompass and UPPAAL. (Within the project an AUTOSAR model in ARtext and time constraints in ARtime were defined. It was not possible to verify these constraints, due to a missing toolchain from AUTOSAR models into the simulation environment.)
Type	«Validation»
Priority	High
Description	EAST-ADL supports the definition of timing of constraints by the inclusion of the TADL language. A verification of the TADL constraints shall be possible. It is an option to verify TADL constraints either by the use of timing analysis techniques as provided by languages as MARTE or AADL or model simulation techniques as provided by Modelica. Within the scope of the project, it has to be evaluated, if the verification of timing constraints on base of these techniques is possible and samples shall be given.
Derived from	• CON#0012 Define time constraints and enable verification of time constraints

CON#1022: CVM for requirements & use cases	
Alias	CVM for requirements & use cases
Status	Rejected

Status Comment	This topic was not further taken into consideration.
Type	«Concept»
Priority	Medium
Description	It has to be investigated, if the CVM tooling can be also an editor for requirements and use cases in the same way as for features. CVM has advantages over a UML tooling when dealing with text based elements. (Graphic, Links) This is of course some amount of work, especially when some reasonable integration into papyrus is worked out. Also the relationship between UseCases, Requirement and Features can be further refined in such an activity. If due to the amount of work, CVM is not developed in this direction, the use of the required modeling capabilities of TopCased - SysML and their co-use with EAST-ADL shall be evaluated. TopCased focuses on a Tool environment (requirements tracing, document generation, simulation,...) whereas Papyrus focuses on UML. As soon as Papyrus MDT becomes more mature it is foreseen as the standard modeling tool for UML, SysML within TopCased.
Derived from	• CON#0022: CVM for requirements & use cases

CON#2001: Support driving profiles	
Alias	Support driving profiles
Status	Addressed
Status Comment	Driving profiles represent modes in an AUTOSAR system.
Type	«Language»
Priority	Medium
Description	Clarify whether we need language extensions for supporting driving profiles. Derived from Use Case CON#0001.
Derived from	• CON#0001: Adopt ID4EV use cases

CRF#0004b Insulation	
Alias	ISO 6469-1and UNECE R100 / Insulation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the insulation resistance of the RESS (Rechargeable energy storage system). For a RESS not embedded in a whole circuit, the minimum requirement for the insulation resistance Ri divided by its maximum working voltage shall be 100 Ω/V, if not containing AC, or 500 Ω/V, if containing AC without additional AC protection throughout the entire lifetime of the RESS. When the RESS is integrated in a whole electric circuit, a higher resistance value for the RESS may be necessary. The measurement shall be done following the recommended procedure after a preconditioning and conditioning period.
Derived from	

CRF#0005b Creepage and clearance distance	
Alias	ISO 6469-1 / Creepage and clearance distance
Status	Addressed

Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements on clearance and creepage distance between RESS terminals. a) In the case of a creepage distance between two RESS connection terminals: d W 0,25U + 5 b) In the case of a creepage distance between live parts and the electric chassis: d W 0,125U + 5 where d is the creepage distance between the live part and the electric chassis, in millimeters (mm); U is the maximum working voltage between the two RESS connection terminals, in volts (V). The clearance between conductive surfaces shall be 2.5 mm minimum.
Derived from	

CRF#0006b Heat generation	
Alias	ISO 6469-1 and UNECE R100 / Heat generation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account heat generation by the RESS under first-failure conditions. Heat generation under any first-failure condition, which could form a hazard to persons, shall be prevented by appropriate measures, e.g. based on monitoring of current, voltage or temperature.
Derived from	

CRF#0007b Gases emission	
Alias	ISO 6469-1 and UNECE R100 / Gases emission
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account emission of hazardous gases by the RESS. No potentially dangerous concentration of hazardous gases and other hazardous substances shall be allowed anywhere in the driver, passenger and load compartments. Refer to the latest version of applicable National/International Standards or regulations for the maximum allowed accumulated quantity of hazardous gases and other substances. Appropriate countermeasures shall manage first-failure situations.

Derived from	

CRF#0008b RESS over-current interruption	
Alias	ISO 6469-1 / RESS over-current interruption
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the interruption of RESS over-current. If a RESS system is not short-circuit proof in itself, a RESS over-current interruption device shall open the RESS circuit under conditions specified by the vehicle and/or RESS manufacturer.
Derived from	

CRF#0009b Crash-test requirements	
Alias	ISO 6469-1 / Crash-test requirements
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account specific RESS crash-test requirements. The following requirements shall be met in a crash test, in accordance with the test requirements of applicable National and/or International Standards or regulations or standards: a) If the RESS is located outside the passenger compartment, it shall not penetrate into the passenger compartment. b) If the RESS is located inside the passenger compartment, movement of the RESS shall be limited to ensure the safety of the occupants. c) No spilled electrolyte shall enter the passenger compartment during and after the test.
Derived from	

CRF#0010b Power-on procedure	
Alias	ISO 6469-2 / Power-on procedure
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements on power-on/power off procedure. At least two deliberate, distinct actions shall be performed in order to go from the “power-off” mode to the “driving enabled” mode. a) Power-off: the propulsion system is off; no active driving of the vehicle is possible in this mode. b) Driving enabled: only in this mode will the vehicle move when the accelerator device

	is applied. After an automatic or manual turn-off of the propulsion system, it shall only be possible to reactivate the system by the specified power-on procedure.
Derived from	

CRF#0011b Propulsion system status indication	
Alias	ISO 6469-2 / Propulsion system status indication
Status	Addressed
Status Comment	Addressed in FEV swimlane of MAENAD methodology and part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the indication of the propulsion system status. An obvious device (e.g. a visual or audible signal) shall indicate permanently or temporarily that the propulsion system is ready for driving.
Derived from	

CRF#0012b Connection to power supply	
Alias	ISO 6469-2 / Connection to power supply
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the connection of the vehicle to an off-board electric power supply. Vehicle movement by its own propulsion system shall be impossible when the vehicle is physically connected to an external electrical network (e.g. mains, off-board charger).
Derived from	

CRF#0013b RESS state indications	
Alias	ISO 6469-2 / RESS state indications
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the indication of reduced power and low energy content of RESS. If the power is automatically reduced to a significant extent (e.g. by high temperature of the power unit or of the energy source component), this shall be indicated to the driver by an obvious device such as a visual or audible signal. A low state of charge of the traction battery shall be indicated to the driver by an obvious device. At the indicated low state of charge specified by the vehicle manufacturer, the vehicle shall meet the following requirements: a) It shall be possible to move the vehicle out of the traffic area by its own propulsion system.

	b) A minimum energy reserve shall still be available for the lighting system as required by national and/or international standards or regulations, when there is no independent energy storage for the auxiliary electrical circuit.
Derived from	

CRF#0014b Driving backward	
Alias	ISO 6469-2 / Driving backward
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for driving backward. If driving backwards is achieved by reversing the rotational direction of the electric motor, the following requirements shall be met to prevent unintentional switching into reverse when the vehicle is in motion: a) switching between the forward and backward (reverse) directions shall require either two separate actions by the driver, or b) if only one driver action is required, a safety device shall allow the transition only when the vehicle is stationary or moving slowly. The maximum reverse speed shall be limited.
Derived from	

CRF#0015b Parking	
Alias	ISO 6469-2 / Parking
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for parking. When leaving the vehicle, the driver shall be informed by an obvious device (e.g. a visual or audible signal) if the propulsion system is still in the driving enabled mode. If the electric motor continues to rotate when the vehicle is stationary, no unintended movement of the vehicle shall be possible after switching to the power-off mode.
Derived from	

CRF#0016b Electromagnetic compatibility	
Alias	ISO 6469-2 / Electromagnetic compatibility
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for electromagnetic susceptibility and emissions. The electric road vehicle shall be tested for susceptibility according to ISO 11451-2.

	The reference field strength shall be a minimum of 30 V/m rms or according to national standards or regulations. Care shall be taken to minimize electromagnetic emissions from the electric road vehicle, taking into account national standards or regulations and international standards. Vehicle functions enabled by the auxiliary circuits shall meet the relevant national and/or international standards or regulations during operation of the vehicle, particularly those related to lighting, signaling and safety functions.
Derived from	

CRF#0017b Protection against failure	
Alias	ISO 6469-2 / Protection against failure
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for fail-safe design, first failure response and unintentional vehicle behavior. Unintentional acceleration, deceleration and reversal of the propulsion system shall be prevented. In the event of a single failure (e.g. in the power control unit) of a stationary, unbraked vehicle, the propulsion shall be cut off to prevent unintended vehicle movement. Unintended steering effects from different torques while driving or braking that are greater than those of IC engine-propelled vehicles shall not occur.
Derived from	

CRF#0018b Emergency response	
Alias	ISO 6469-2 / Emergency response
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for emergency response. The manufacturer of the vehicle shall have information available for safety personnel and/or emergency responders with regard to dealing with accidents involving a vehicle.
Derived from	

CRF#0019b Marking	
Alias	ISO 6469-3 and UNECE R100 / Marking
Status	Addressed
Status Comment	Addressed by user defined attributes and part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for marking high voltage components and high voltage wiring.

	The outer covering of cables and harness for high voltage circuits, not within enclosures or behind barriers shall be marked with orange color.
Derived from	

CRF#0020b Protection against electric shock	
Alias	ISO 6469-3 and UNECE R100 / Protection against electric shock
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for basic protection measures and protection under first-failure conditions against electric shock.
Derived from	

CRF#0021b Insulation	
Alias	ISO 6469-3 / Insulation
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for insulation of high voltage live parts. If protection is provided by insulation, the live parts of the electric system shall be totally encapsulated by insulation which can be removed only by destruction. The insulating material shall be suitable to the maximum working voltage and temperature ratings of the vehicle and its systems. The insulation shall have sufficient withstand voltage capability.
Derived from	

CRF#0022b Barriers and enclosures	
Alias	ISO 6469-3 / Barriers and enclosures
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for barriers and enclosures to prevent electrical shock. If protection is provided by barriers/enclosures, live parts shall be placed inside enclosures or behind barriers, preventing access to the live parts from any usual direction of access. The barriers/enclosures shall provide sufficient mechanical resistance under normal operating conditions, as specified by the manufacturer. If barriers/enclosures are accessible directly they shall be opened or removed only by use of tools or maintenance keys or they shall have means to deactivate live parts with high voltage, e.g. interlock.
Derived from	

CRF#0023b Insulation resistance	
Alias	ISO 6469-3 and UNECE R100 / Insulation resistance
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for the insulation resistance of the high voltage systems. If the protection measures chosen (see 7.3) require a minimum insulation resistance, it shall be at least 100 Ω/V for DC circuits and at least 500 Ω/V for AC circuits. The reference shall be the maximum working voltage.
Derived from	

CRF#0024b Withstand voltage	
Alias	ISO 6469-3 / Withstand voltage
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for withstand voltage capability of the high voltage components and wiring. The high voltage components and wiring shall fulfill the applicable sections of IEC 60664-1 or meet the withstand voltage capability according to the withstand voltage test described.
Derived from	

CRF#0025b Potential equalization	
Alias	ISO 6469-3 and UNECE R100 / Potential equalization
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for components and path for the potential equalization. All components forming the potential equalization current path (conductors, connections) shall withstand the maximum first failure current in a maximum fault clearance time. The resistance of the potential equalization path between any two exposed conductive parts of the high voltage electric circuit which can be touched simultaneously by a person shall not exceed 0.1 Ohm.
Derived from	

CRF#0026b Charging inlet	
Alias	ISO 6469-3 and UNECE R100 / Charging inlet
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»

Priority	High
Description	The EAST-ADL approach shall take into account requirements for the vehicle charging inlet. One second after having disconnected the charge coupler, the voltage of the vehicle inlet shall be less than or equal to 30 V AC or 60 V DC. This condition is not necessary if vehicle inlet complies with the requirement of at least IPXXB.
Derived from	

CRF#0027b Insulation resistance test	
Alias	ISO 6469-3 and UNECE R100/ Insulation resistance test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedures for the insulation resistance test.
Derived from	

CRF#0028b Withstand voltage test	
Alias	ISO 6469-3 / Withstand voltage test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedures for withstand voltage capability test.
Derived from	

CRF#0029b Potential equalization test	
Alias	ISO 6469-3 / Potential equalization test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for the potential equalization components and path test.
Derived from	

CRF#0030b Protection against electric shock after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Protection against electric shock after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).

Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for protection of persons against electric shock after vehicle crash test.
Derived from	

CRF#0031b Electrolyte spillage after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Electrolyte spillage after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for electrolyte spillage after vehicle crash test.
Derived from	

CRF#0032b RESS retention after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / RESS retention after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements for RESS retention after vehicle crash test.
Derived from	

CRF#0033b Test for protection against electric shock after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Test for protection against electric shock after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for protection against electric shock test after vehicle crash test.
Derived from	

CRF#0034b Test for electrolyte spillage after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / Test for electrolyte spillage after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).

Type	«Safety»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for electrolyte spillage test after vehicle crash test.
Derived from	

CRF#0035b test for RESS retention after crash test	
Alias	R94 new EV proposals and R95 new EV proposals / test for RESS retention after crash test
Status	Addressed
Status Comment	Part of Design Methodology Checklist for FEVs (see chapter 5 of D2.2.1).
Type	«Non-Function»
Priority	High
Description	The EAST-ADL approach shall take into account requirements and procedure for RESS retention test after vehicle crash test.
Derived from	

CRF#0046b SEooC	
Alias	ISO 26262 / SEooC
Status	Addressed
Status Comment	EAST-ADL supports SEooC approach.
Type	«Safety»
Priority	High
Description	Maenad approach shall support the ISO 26262 SEooC concept.
Derived from	

CRF#0047b hazard analysis and risk assessment	
Alias	ISO 26262 - 3 / hazard analysis and risk assessment
Status	Addressed
Status Comment	MAENAD methodology includes the hazard analysis and risk assessment. Moreover, EAST-ADL includes the concepts necessary to describe this kind of analysis.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 hazard analysis and risk assessment.
Derived from	

CRF#0048b ASIL determination	
Alias	ISO 26262 - 3 / ASIL determination
Status	Addressed
Status Comment	MAENAD methodology includes the ASIL determination. Moreover, EAST-ADL includes the concepts necessary to describe this kind of analysis.

Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 ASIL determination.
Derived from	

CRF#0049b Safety Goal	
Alias	ISO 26262 - 3 / Safety Goal
Status	Addressed
Status Comment	MAENAD methodology includes the Safety Goal definition. Moreover, EAST-ADL includes the concepts necessary to define safety goal in the model.
Type	«Safety»
Priority	High
Description	Maenad approach shall support Safety Goal and safe state definition.
Derived from	

CRF#0050b External measures	
Alias	ISO 26262 - 3 / External measures
Status	Addressed
Status Comment	MAENAD methodology includes the external measures definition. Moreover, EAST-ADL supports external measures modeling.
Type	«Safety»
Priority	High
Description	Maenad approach shall support external measures definition.
Derived from	

CRF#0051b functional safety requirements	
Alias	ISO 26262 - 3 / functional safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes the functional safety requirements definition. Moreover, EAST-ADL supports the modeling of the safety requirements.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 functional safety requirements definition, including all necessary parameters (Operating modes, fault tolerant time interval, eventually safe state, emergency operation interval, functional redundancies).
Derived from	

CRF#0052b functional safety requirements allocation	
Alias	ISO 26262 - 3 / functional safety requirements allocation
Status	Addressed
Status Comment	MAENAD methodology includes these activities. Moreover, HiP-HOPS can support this part of the safety activity.

Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 functional safety requirements allocation.
Derived from	

CRF#0053b technical safety requirements	
Alias	ISO 26262 - 4 / technical safety requirements
Status	Addressed
Status Comment	MAENAD methodology includes the technical safety requirements definition. Moreover, EAST-ADL supports the modeling of the safety requirements.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 technical safety requirements definition.
Derived from	

CRF#0054b safety mechanism	
Alias	ISO 26262 - 4 / safety mechanism
Status	Addressed
Status Comment	Addressed in MAENAD methodology (functional safety swimlane). EAST-ADL allows for the definition of the safety mechanism via error modeling support and its links to the nominal model.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ISO 26262 safety mechanism definition.
Derived from	

CRF#0055b latent faults	
Alias	ISO 26262 - 4 / latent faults
Status	Addressed
Status Comment	Addressed in MAENAD methodology (functional safety swimlane). The EAST-ADL error model supports definition of latent failures; methodology and analysis algorithm support exists within MAENAD to use these as part of the ISO 26262 safety process to try to mitigate such failures.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid latent faults.
Derived from	

CRF#0056b random H/W failures	
Alias	ISO 26262 - 4 / random H/W failures
Status	Addressed

Status Comment	Addressed in MAENAD methodology (functional safety swimlane). The EAST-ADL error model supports definition of random H/W failures; methodology and analysis algorithm support exists within MAENAD to use these as part of the ISO 26262 safety process to try to mitigate such failures.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid random HW faults.
Derived from	

CRF#0057b systematic failures	
Alias	ISO 26262 - 4 / systematic failures
Status	Addressed
Status Comment	Addressed in MAENAD methodology (functional safety swimlane). The EAST-ADL error model supports definition of systematic failures; methodology and analysis algorithm support exists within MAENAD to use these as part of the ISO 26262 safety process to try to mitigate such failures.
Type	«Safety»
Priority	High
Description	Maenad approach shall support safety mechanism definition to avoid systematic faults.
Derived from	

CRF#0058b ASIL Decomposition	
Alias	ISO 26262 - 9 / ASIL Decomposition
Status	Addressed
Status Comment	Automatic ASIL decomposition has been achieved and is being further refined.
Type	«Safety»
Priority	High
Description	Maenad approach shall support ASIL decomposition.
Derived from	

CRF#0059b Safety case	
Alias	ISO 26262 /Safety case
Status	Addressed
Status Comment	MAENAD methodology and EAST-ADL language support safety case definition.
Type	«Safety»
Priority	High
Description	Maenad approach shall support Safety case specification.
Derived from	

CRF#0061b functional safety assessment

Alias	ISO 26262 - 2 / functional safety assessment
Status	Addressed
Status Comment	EAST-ADL and MAENAD support the various activities required by functional safety assessment as defined in ISO 26262, though further refinement of these processes may continue until the end of the project.
Type	«Safety»
Priority	High
Description	Maenad approach shall support functional safety assessment.
Derived from	

DOW#2000 Architectural Patterns	
Alias	Architectural Patterns
Status	Addressed
Status Comment	The definition of a collection of architectural patterns is an ongoing task in WP3. A set of patterns usable in e.g. optimization is expected to be ready by the end of the project.
Type	«Non-Function»
Priority	Medium
Description	Standard architectural patterns for optimization and refinement shall be defined.
Derived from	• WP3 • DOW#0015 O3-2

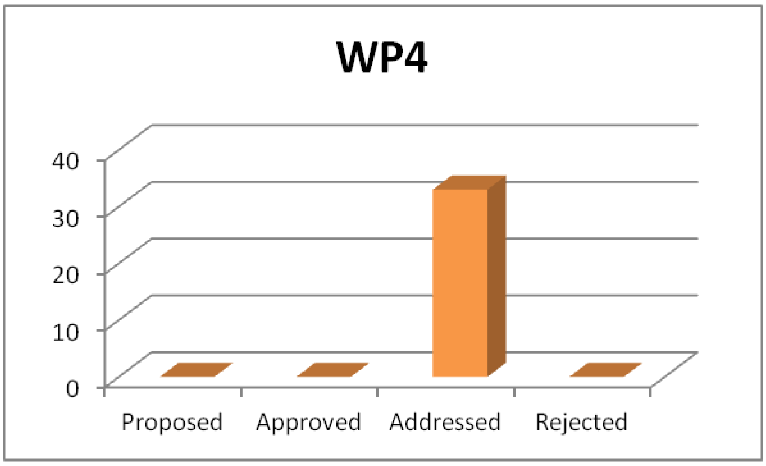
UOH#0001 Error_Model_Analysis_Support	
Alias	Error_Model_Analysis_Support
Status	Addressed
Status Comment	Safety requirements are supported by error model and safety constraints. FTA and RBD can be supported as views/analysis of the error model.
Type	«Safety»
Priority	High
Description	The EAST-ADL error model should fully support the necessary concepts to allow dependability analysis, including safety requirements/constraints (e.g. ASILs).
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262

UOH#0002 Error Model Optimization Support	
Alias	Error Model Optimization Support
Status	Addressed
Status Comment	As 1:1 mapping is maintained between the nominal and error architectures, EAST-ADL supports optimization. This has been demonstrated via the OptiPal tool, which works on a subset of EAST-ADL.
Type	«Non-Function»
Priority	Medium
Description	The EAST-ADL error model should support automatic multi-objective optimization of the model with regard to safety and reliability, with the option to extend optimization to other characteristics such as timing. This will require both mechanisms for describing substitutability amongst system ele-

	ments and also a 1:1 mapping between nominal and error models (because HiP-HOPS will make use of the error model to perform the optimization and any optimizations it makes will need to be reflected in the nominal model too).
Derived from	

7.5 WP4 - Language Definition

Requirements that relate to the formal definition of the language, profile and schema are listed below.



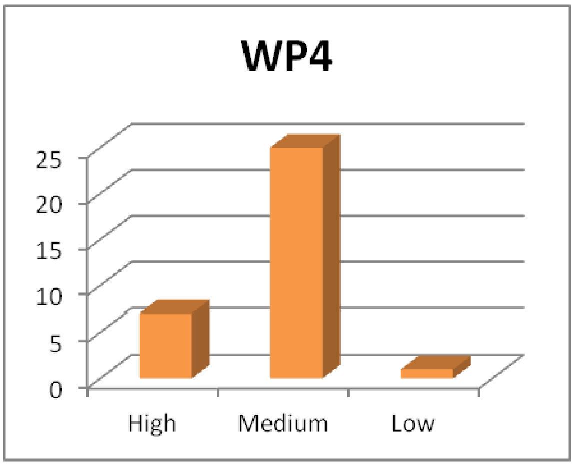


Figure 13: Status and priorities

CRF#0045 ISO 26262 compliance	
Alias	EAST-ADL /ISO 26262 compliance
Status	Addressed
Status Comment	WT4.1 proposes updates of the dependability package and new timing events for • EventFaultFailure • EventFeatureFlaw • EventState
Type	«Safety»
Priority	High
Description	EAST-ADL shall support ISO 26262
Derived from	

KTH#0003 Modular_explicitness	
Alias	Modular_explicitness
Status	Addressed
Status Comment	The organization of the overall language into a core and independent extensions has been strengthened. There are no references from the core to the extensions. WT4.1: where the language specification includes dependencies between packages, they have been made explicit and shown in a diagram of the language specification.
Type	«Integration»
Priority	High
Description	Dependencies between extensions should be explicit. If one extension depends on another, this should be made explicit.
Derived from	• KTH#0002 Language_Modularity

KTH#0004 CMM_compatibility	
Alias	CMM_compatibility
Status	Addressed
Status Comment	WT4.1: The Cesar metamodel is based on domain specific concepts from EAST-ADL and HRC with general component based design concepts from the SPEEDS project.
Type	«Integration»
Priority	Low
Description	The metamodel should be compatible with the metamodel of the CESAR project
Derived from	• KTH#0008 Standardization
Refined by	• KTH#0009 Using CMM compatible tools

KTH#1002 Language Modularity	
Alias	Versioning Scheme for the language
Status	Addressed / partly Rejected
Status Comment	WT4.1: The language dependencies are explicit (compare KTH#0003). The requirement is partly rejected: The project does not have separate versioning for extensions.
Type	«Language»
Priority	High
Description	Define a versioning scheme for the language, with independent version numbers for the core and the extensions. This versioning should be used project internally only. The language should be modular and the extensions versioned separately. E.g. update of the core should not be necessary because of a change in an extension.
Derived from	• KTH#0002 Language_Modularity
Refined by	• KTH#2002 Language_Modularity

KTH#2002 Language Modularity	
Alias	Versioning scheme for the profile
Status	Addressed / partly Rejected
Status Comment	WT4.1: The language dependencies are explicit (compare KTH#0003). The requirement is partly rejected: The project does not have separate versioning for extensions.
Type	«Language»
Priority	High
Description	Define a versioning scheme for the profile, with independent version numbers for the core and the extensions. This versioning should be used project internally only. The language should be modular and the extensions versioned separately. E.g. update of the core should not be necessary because of a change in an extension.
Derived from	• KTH#1002 Language_Modularity
Refined by	• KTH#0005 Tool_Modularity

TUB#0005 Proof of Datatype Concepts	
Alias	Proof of Datatype Concepts

Status	Addressed
Status Comment	Addressed by the demonstrators. WT4.1: Extensive refinement of datatypes (incl. alignment with TIMMO) has been done in May/June 2012. New value concepts are proposed to be added. These concepts are used for values in e.g. user attributes. All this has been made available in EAST-ADL language version 2.1.11.
Type	«Integration»
Priority	High
Description	The datatype package of EAST-ADL2 has been reengineered at the end of ATESST2. A detailed review on the newly introduced concepts and meta-structures is still out-standing. Thus a small expert group should make a detailed review on this package. An example using all the concepts of the datatype package should be created. The datatype concepts should also be proofed to be sufficient when using them in the con-text of other EAST-ADL2 concepts (e.g. parameterized features or user attributes).
Derived from	

TUB#0006 Mapping between EAST-ADL2 Domain Model Concepts and UML Concepts	
Alias	Mapping between EAST-ADL2 Domain Model Concepts and UML Concepts
Status	Addressed
Status Comment	WT4.1: The metamodel do document proposed UML extensions. To ease tool imple-mentation an abstract superstructure is proposed by adding EAType, EAPrototype, EAPort and EAConnector. The RIFImportArea is proposed to be removed from the language (compare TUB#0009). Explicit mapping from the language on UML concepts by extension is implemented in the EAST-ADL UML Profile.
Type	«Integration»
Priority	Medium
Description	A small expert group should review the mapping between EAST-ADL2 Domain Model Concepts and the UML concepts that are targets for the appropriate EAST-ADL2 UML stereotypes (e.g. base_Class, base_Package etc.). E.g., it should be discussed, whether a RIFImportArea should become a UML Class or a UML Package. RIFImportArea is only one example. Of course, the discussion should be focus the whole EAST-ADL2 language.
Derived from	

TUB#0007 Accessible Language Specification	
Alias	Accessible Language Specification
Status	Addressed
Status Comment	WT4.1: The documentation texts have been reviewed and consolidated in version M.2.1.10.
Type	«Language»
Priority	Medium
Description	The EAST-ADL language specification shall be further improved with respect to under-standability and semantic precision/completeness. Other standard specifications may be reviewed as an example of how to improve the specification text.
Derived from	

TUB#0008 ReqIF Alignment	
Alias	Alignment of EAST-ADL Requirements package to ReqIF standard
Status	Addressed
Status Comment	WT4.1: The Requirement package is proposed to be updated and aligned with ReqIF and the UserAttribute package is proposed to be updated. This is available in EAST-ADL language version 2.1.11.
Type	«Language»
Priority	High
Description	The EAST-ADL Requirements package was designed with RIF in mind, but meanwhile this standard was updated and replaced by the new OMG standard ReqIF. EAST-ADL should be aligned accordingly. This might also have an impact on the User Attributes in EAST-ADL.
Derived from	

TUB#0009 Reconsider Multi-Level and Extension Containers	
Alias	Reconsider EAST-ADL Multi-Level concept and Extension Containers
Status	Addressed
Status Comment	WT4.1: The MultiLevelReference concept is proposed to be removed. The term “extension containers” in the requirement refers to the RIFExportArea and RIFImportArea elements in EAST-ADL, these concepts are proposed to be removed. In EAST-ADL language version 2.1.11 the multi-level concept and RIFExportArea and RIFImportArea were removed.
Type	«Language»
Priority	Medium
Description	The Multi-Level concept and Extension Containers in EAST-ADL are a very complex concept, are currently seldom used, and could be treated as an orthogonal aspect that is supplied outside the EAST-ADL language by tools. Therefore, these concepts might be removed from the language in order to simplify the EAST-ADL domain model. To be investigated and discussed.
Derived from	

TUB#1003 ChangeProcess	
Alias	ChangeProcess
Status	Addressed
Status Comment	MAENAD wiki and ticket system set up. This defines change process.
Type	«Collabor.»
Priority	High
Description	Change requests and the corresponding discussions in the project shall be managed in a transparent, organized process.
Derived from	• TUB#0003 ChangeProcess

TUB#1004 ChangeDocumentation	
Alias	ChangeDocumentation
Status	Addressed

Status Comment	MAENAD wiki and ticket system set up. This defines change documentation. Proposed changes are documented (MAENAD_LanguagesChanges_M.2.1.11.doc).
Type	«Collabor.»
Priority	Medium
Description	Change requests and the corresponding discussions shall be documented in a form that makes them accessible for reference in the future. Comment: see also TUB#1003
Derived from	• TUB#0004 ChangeDocumentation

4SG#0057 Functional safety requirements attributes	
Alias	Functional safety requirements attributes
Status	Addressed
Status Comment	Addressed by the dependability concepts.
Type	«Language»
Priority	Medium
Description	The language shall enable the description of the functional safety requirements including all required attributes. **Attributes of the safety requirements (for each hazardous event)** • Safety goals • Operating modes • Fault tolerant time interval • Possible safe state • Transitions to and from the safe state • Emergency operation interval • Functional redundancies • Driver warning • Degraded operation • Driver's actions
Derived from	• 4SG#0053: ISO 26262-4 Functional safety requirements

4SG#0061 Functional safety concept attributes	
Alias	Functional safety concept attributes
Status	Addressed
Status Comment	All attributes of functional safety concept are addressed by EAST-ADL (see examples).
Type	«Language»
Priority	Medium
Description	The language shall enable the definition of the functional safety concept including all required attributes. **Attributes** • Functional safety requirements • Item functional description and requirement allocation • Interaction description with vehicle systems • Functional specifications to achieve the safety goals • Description of the external measures to avoid or mitigate the effects of the hazards
Derived from	• 4SG#0054: ISO26262-3 Functional safety concept

4SG#0063 Technical safety requirements attributes	
Alias	Technical safety requirements attributes
Status	Addressed
Status Comment	All attributes of technical safety requirements are addressed by EAST-ADL (see examples). For details see following table: **Attribute** — **Definition means** Interfaces including communication and HMI (if applicable) — Requirements Environmental and functional constraints — Requirements Configuration requirements — Variability tool Response to stimuli — Simulation tool, requirements Safety mechanisms (fault detection and control) — Requirements and functional diagrams (finite state machines, sequence diagrams, etc.)
Type	«Language»
Priority	Medium

Description	The language shall enable the definition of the technical safety requirements including all required attributes.
	
	Attributes of the technical safety requirements:
	- Interfaces including communication and HMI (if applicable)
	- Environmental and functional constraints
	- Configuration requirements
	- Response to stimuli
	- Safety mechanisms (fault detection and control):
	  - detection, indication and control of faults of the item
	  - detection, indication and control of faults in external devices that interact with the system
	  - measures that enable the system to achieve or maintain a safe state
	  - measures to detail and implement the warning and degradation concept
	  - measures which prevent faults from being latent
	  - measures to detail and implement the warning and degradation concept
	  - the transition to the safe state, including the requirements to control the actuators
	  - the fault tolerant time interval
	  - the emergency operation interval, if the safe state cannot be reached immediately the measures to maintain the safe state.

Derived from	• 4SG#0055: ISO 26262-4 Technical safety requirements

Status Comment table:

Attribute	Definition means
Interfaces including communication and HMI (if applicable)	Requirements
Environmental and functional constraints	Requirements
Configuration requirements	Variability tool
Response to stimuli	Simulation tool, requirements
Safety mechanisms (fault detection and control)	Requirements and functional diagrams (finite state machines, sequence diagrams, etc.)

4SG#0076: 6469-1 - Insulation modeling	
Alias	6469-1 - Insulation modeling
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall enable modeling of insulation, including: - Insulation symbols - Insulation attributes (withstand voltage, resistance, presence of DC or AC parts, creepage distance, ref. to standards...) - Insulation devices (to describe the interconnection between isolated and not isolated physical parts, e.g. communication, power supply, drives) - High voltage parts (wrt physical view) in order to take note of the requirements regarding creepage distance, clearance, labeling, wire color, insulation.

Derived from	• 4SG#0007: ISO 6469-1

4SG#0080: 6469-1 - RESS interruption device modeling	
Alias	6469-1 - RESS interruption device modeling
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall enable modeling of an over-current interruption device, including power-flow paths and interruption characteristics (current-time characteristics). Note: RESS: Regenerative Energy Storage System.
Derived from	• 4SG#0007: ISO 6469-1

4SG#0091: 6469-3 - Language requirements concerning potential equalization	
Alias	6469-3 - Language requirements concerning potential equalization
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall enable the representation of bonding/grounding of physical elements (proper symbols).
Derived from	• 4SG#0009: ISO 6469-3

4SG#0105: J2289 - Key-on discharge (Language)	
Alias	J2289 - Key-on discharge (Language)
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall provide means to model: - the power supply network including fault protection devices with their current-time characteristics - the auxiliary equipment including power requirements/ power profiles.
Derived from	• 4SG#0018: J2289

4SG#0108: J2289 - Key-on Regen operation (Language)	
Alias	J2289 - Key-on Regen operation (Language)
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»

Priority	Medium
Description	The language shall provide means to define: - voltage limit data/ requirements of the drive components - recommended battery current and voltage profiles during high SoC - and to model the battery for current-voltage transients analysis.
Derived from	• 4SG#0018: J2289

4SG#0111: J2289 - Key-on charge (Language)	
Alias	J2289 - Key-on charge (Language)
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall provide means to model the electrical characteristics of the charge system components (e.g. current, voltage).
Derived from	• 4SG#0018: J2289

4SG#0114: J2289 - Key-Off Parked Off Plug Operating (Language)	
Alias	J2289 - Key-Off Parked Off Plug Operating (Language)
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall provide means to describe the power characteristics of the devices running in key-off mode.
Derived from	• 4SG#0018: J2289

4SG#0117: J2289 - Parked Off Plug IDLE/Storage Operation (Language)	
Alias	J2289 - Parked Off Plug IDLE/Storage Operation (Language)
Status	Addressed
Status Comment	Supported by user defined attributes and model library.
Type	«Language»
Priority	Medium
Description	The language shall provide means to model the battery disconnect system (mechanical switch).
Derived from	• 4SG#0018: J2289

4SG#0120: J2289 - Discharge management - Performance limits (Language)	
Alias	J2289 - Discharge management - Performance limits (Language)
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics (WT4.1).

Type	«Language»
Priority	Medium
Description	The language shall provide means to define the operation limits of the battery (temperature ranges, current, under-voltage).
Derived from	• 4SG#0018: J2289

4SG#0123: J2289 - Key-on startup diagnostics and warning (Language)	
Alias	J2289 - Key-on startup diagnostics and warning (Language)
Status	Addressed
Status Comment	Supported by enumeration datatypes and severity attribute.
Type	«Language»
Priority	Medium
Description	The language shall provide means to represent different levels of warnings (depending on the fault severity).
Derived from	• 4SG#0018: J2289

4SG#0127: FMVSS No. 114 - Modeling keylocking device	
Alias	FMVSS No. 114 - Modeling key locking device
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall provide means to model a keylocking device with lock and unlock conditions.
Derived from	• 4SG#0072: FMVSS No. 114 Theft protection

4SG#0134: FMVSS No. 135 Modeling of diagnostics and warning of brake system	
Alias	FMVSS No. 135 Modeling of diagnostics and warning of brake system
Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall provide means to model HMI interface for visual indicators.
Derived from	• 4SG#0071: FMVSS No. 135 Brake system

4SG#0138: ISO 8715 - Performance testing - Terms and definitions	
Alias	ISO 8715 - Performance testing - Terms and definitions
Status	Addressed
Status Comment	Language concepts for modeling are verification and validation. Vehicle level modeling with user defined attributes and expressions (WT4.1). Supported by model library.
Type	«Language»

Priority	Medium
Description	The language shall enable the definition of vehicle performance characteristics according to the terms and definitions given by the standard.
Derived from	• 4SG#0019: ISO 8715

4SG#0139: ISO 8715 - Performance testing - Language for test cases definition	
Alias	ISO 8715 - Performance testing - Language for test cases definition
Status	Addressed
Status Comment	Language concepts for modeling are verification and validation. Vehicle level modeling with user defined attributes and expressions (WT4.1). Supported by model library.
Type	«Language»
Priority	Medium
Description	The language shall enable the definition of the test cases according to the test conditions and test procedures required by the standard. Scope: to define test profiles for simulation.
Derived from	• 4SG#0019: ISO 8715

4SG#0142: ISO 8714 - Energy and range testing - Terms and definitions	
Alias	ISO 8714 - Energy and range testing - Terms and definitions
Status	Addressed
Status Comment	Language concepts for modeling are verification and validation. Vehicle level modeling with user defined attributes and expressions (WT4.1). Supported by model library.
Type	«Language»
Priority	Medium
Description	The language shall enable the definition of vehicle energy consumption and range characteristics according to the terms and definitions given by the standard.
Derived from	• 4SG#0020: ISO 8714

4SG#0143: ISO 8714 - Energy and range testing - Language for energy and range test cases definition	
Alias	ISO 8714 - Energy and range testing - Language
Status	Addressed
Status Comment	Language concepts for modeling are verification and validation. Vehicle level modeling with user defined attributes and expressions (WT4.1). Supported by model library.
Type	«Language»
Priority	Medium
Description	The language shall enable the definition of the test cases according to the test conditions and test procedures required by the standard. Scope: to define test profiles for simulation. Include standard test cycle (European, Japan, USA cycles).
Derived from	• 4SG#0020: ISO 8714

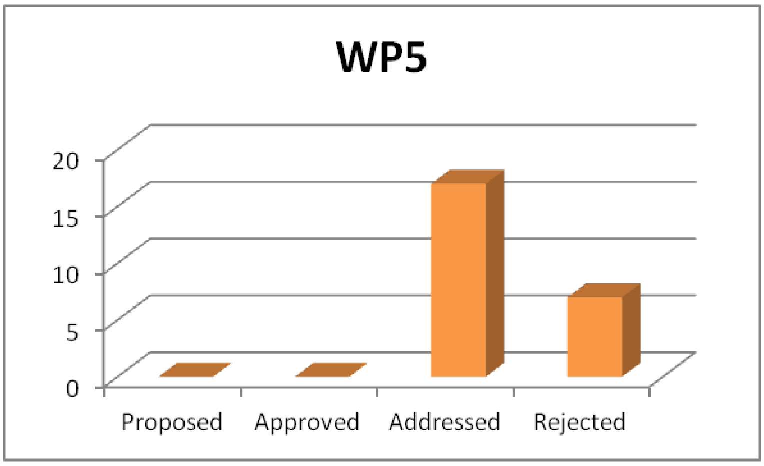
4SG#0146: ISO 12045-2 - Lithium batteries - Language for test purposes	
Alias	ISO 12045-2 - Lithium batteries - Language for test purposes

Status	Addressed
Status Comment	User defined attributes and generic constraints are proposed to be updated with hardware specifics. Also a behavior description annex is proposed to be added (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall enable the definition of battery model parameters according to the test purpose (e.g. energy efficiency, charging and discharging resistance).
Derived from	• 4SG#0023: ISO 12405-2

4SG#0147: ISO 12045-2 - Lithium batteries - Modeling for test purposes	
Alias	ISO 12045-2 - Lithium batteries - Modeling for test purposes
Status	Addressed
Status Comment	Compliance with test and requirements are done with concepts of requirements, constraints, and verification & validation. User defined attributes and generic constraints are proposed to be updated with hardware specifics (WT4.1).
Type	«Language»
Priority	Medium
Description	The language shall enable the modeling in compliance with test conditions requirements (e.g. battery state of charge, power consumption of the auxiliaries, test mass, etc.).
Derived from	• 4SG#0023: ISO 12405-2

7.6 WP5 - Tooling

This section is listing the requirements for modeling and analysis tools.



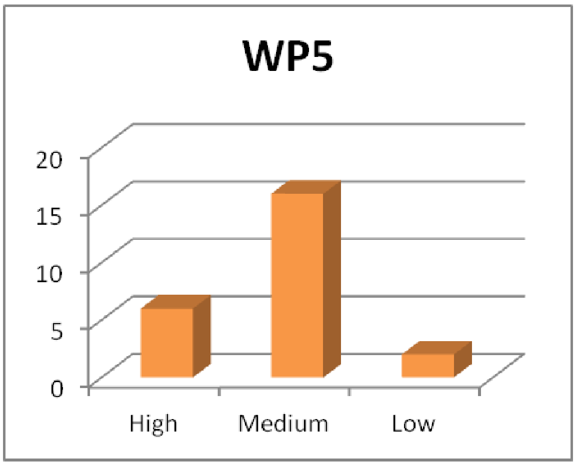


Figure 14: Status and priorities

CON#0020: Integration with Papyrus	
Alias	Integration with Papyrus
Status	Addressed
Status Comment	Papyrus was used as a way to model EAST-ADL models by UML profiles, but modeling concepts as features, behavior and other are hard to apply without dedicated tooling support.
Type	«Tooling»
Priority	Medium
Description	All developed plug-is shall try to improve their integration with the Papyrus tooling. It has to be distinguished between "nice to have" features and features which are really hindering the usage of the plug in (e.g. save or transform a cvm model in UML format).
Derived from	

CON#2022: CVM for requirements & use cases	
Alias	CVM for requirements & use cases
Status	Rejected
Status Comment	This topic was not further taken into consideration.
Type	«Tooling»
Priority	Medium
Description	It has to be investigated, if the CVM tooling can be also an editor for requirements and use cases in the same way as for features. CVM has advantages over a UML tooling when dealing with text based elements. (Graphic, Links) This is of course some amount of work, especially when some reasonable integration into papyrus is worked out. Also the relationship between UseCases, Requirement and Features can be further refined in such an activity. If due to the amount of work, CVM is not developed in this direction, the use of the require modeling capabilities of TopCased - SysML and their co-use with EAST-ADL shall be evaluated. TopCased focuses on a

	Tool environment (Requirements tracing, document, generation, simulation, ...) whereas Papyrus focuses on UML. As soon as Papyrus MDT becomes more mature it is foreseen as the standard modeling tool for UML, SysML within TopCased.
Derived from	• CON#0022: CVM for requirements & use cases

CRF#0062 version compatibility	
Alias	MAENAD Tools / version compatibility
Status	Addressed
Status Comment	Transparent in MetaEdit+, SystemWeaver and Papyrus and minor manual interventions in EATOP.
Type	«Tooling»
Priority	High
Description	The activity (models, architecture description, …) performed at the beginning of the tool release shall continue to be imported also in the new tools versions.
Derived from	

KTH#0001 Language_Evolution	
Alias	Language_Evolution
Status	Addressed
Status Comment	EAST-ADL change control board.
Type	«Integration»
Priority	High
Description	To deal systematically with the language evolution of EAST-ADL to ensure that our investment in demonstrator models is protected and not destroyed by metamodel changes. More specifically this means: the models should be automatically adapted to cope with the changes in the metamodel.
Derived from	
Refined by	• KTH#0011 Meta-model update

KTH#0005 Tool Modularity	
Alias	Tool Modularity
Status	Addressed
Status Comment	Because the language is modular dedicated tools have clear roles.
Type	«Integration»
Priority	Low
Description	The modularity of the language should be reflected on related tools, e.g. HiP-HOPS or Simulink plug-ins.
Derived from	• KTH#2002 Language Modularity

KTH#0006 Transformations Evolution	
Alias	Transformations Evolution

Status	Addressed
Status Comment	Supported by MetaEdit+.
Type	«Integration»
Priority	Low
Description	To deal systematically with the language evolution of EAST-ADL to ensure that our investment in demonstrator models is protected and not destroyed by metamodel changes. More specifically this means that the model transformations (to HiP-HOPS, Simulink etc.) need to be automatically adapted to cope with the changes in the metamodel.
Derived from	

UOH#0003 HiP-HOPS Support	
Alias	HiP-HOPS Support
Status	Addressed
Status Comment	Prototype ASIL decomposition support has been achieved and is being further refined; some other ISO-compatible analyses (e.g. FTA) are also possible.
Type	«Safety»
Priority	High
Description	The HiP-HOPS analysis tool should, where possible, support ISO 26262 or related concepts (such as ASIL decomposition) necessary to allow ISO-compatible dependa-bility analysis of EAST-ADL models.
Derived from	• DOW#0004 O1: Develop capabilities for modeling and analysis support, following ISO 26262

UOH#0004 HiP-HOPS Integration	
Alias	HiP-HOPS Integration
Status	Addressed
Status Comment	The first part (EAST-ADL -> HiP-HOPS) has been achieved in some tools. The second part (storing the results back) is unlikely to be achieved.
Type	«Tooling»
Priority	High
Description	EAST-ADL and HiP-HOPS should be able to intercommunicate by means of model transformations provided by a dependability plug-in in the MAENAD Analysis Work-bench (MAW). Furthermore it should be possible to import or store the results from HiP-HOPS in the Workbench and/or the EAST-ADL model, which will require establishing some form of (perhaps XML based) interchange format.
Derived from	• DOW#0011 O2-1

UOH#0005 Optimization_Integration	
Alias	Optimization_Integration
Status	Addressed
Status Comment	Addressed by OptiPal optimization prototype. Common interface for analysis exten-sions based on Eclipse extension points.
Type	«Tooling»

Priority	Medium
Description	To support multi-objective optimization, there must be a standardized way of passing design candidates to analysis tools/plug-ins and receiving results in a given format.
Derived from	• DOW#0014 O3-1

VTEC#Req101 Model Exchange	
Alias	Model Exchange
Status	Addressed
Status Comment	Through EAXML it is possible to exchange EAST-ADL models. There is already significant exchange coverage across Maenad tools.
Type	«Tooling»
Priority	High
Description	It shall be possible to exchange the same model between different tools.
Derived from	

SYS#0001 Req Model Transformation Model	
Alias	Integration between SystemWeaver and MetaEdit+
Status	Addressed
Status Comment	Addressed for HAD.
Type	«Tooling»
Priority	High
Description	Integration between MetaEdit+ and SystemWeaver shall be realized through the intermediate EAXML.
Derived from	

4SG#0077: 6469-1 - Insulation analysis	
Alias	6469-1 - Insulation analysis
Status	Rejected
Status Comment	EAST-ADL has concepts for annotation and modeling of static properties but analysis tool integration is lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support insulation analysis: overall resistance, voltage compliance.
Derived from	• 4SG#0007: ISO 6469-1

4SG#0081: 6469-1 - RESS short circuit analysis	
Alias	6469-1 - RESS short circuit analysis
Status	Rejected
Status Comment	EAST-ADL has concepts for non-causal modeling but analysis tool integration is lacking.
Type	«Tooling»

Priority	Medium
Description	Maenad tools should support insulation RESS short circuit analysis (current and thermal effect analysis).
Derived from	• 4SG#0007: ISO 6469-1

4SG#0093: 6469-3 - Analysis of charging inlet disconnection	
Alias	6469-3 - Analysis of charging inlet disconnection
Status	Rejected
Status Comment	EAST-ADL has concepts for non-causal modeling but analysis tool integration is lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the analysis of charging inlet voltage decrease when the connector is disconnected.
Derived from	• 4SG#0009: ISO 6469-3

4SG#0098: EN 61851 - Analysis of stored energy – discharge of capacitors	
Alias	EN 61851 - Analysis of stored energy – discharge of capacitors
Status	Rejected
Status Comment	EAST-ADL has concepts for non-causal modeling but analysis tool integration is lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the analysis of the voltage transient of any accessible part after EV disconnection.
Derived from	• 4SG#0016: EN 61851

4SG#0106: J2289 - Key-on discharge (Tooling)	
Alias	J2289 - Key-on discharge (Tooling)
Status	Addressed
Status Comment	Addressed by UPPAAL and generic constraints.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support: - Power and energy analysis to estimate range, taking into account auxiliaries consumption - Time analysis of fault protection intervention
Derived from	• 4SG#0018: J2289

4SG#0109: J2289 - Key-on Regen operation (Tooling)	
Alias	J2289 - Key-on Regen operation (Tooling)
Status	Rejected
Status Comment	EAST-ADL has concepts for non-causal modeling but analysis tool integration is lacking.

Type	«Tooling»
Priority	Medium
Description	Maenad tools should support: the analysis of voltage transients during regenerative braking.
Derived from	• 4SG#0018: J2289

4SG#0112: J2289 - Key-on charge (Tooling)	
Alias	J2289 - Key-on charge (Tooling)
Status	Rejected
Status Comment	EAST-ADL has concepts for annotation and modeling of static properties but analysis tool integration is lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support: the matching analysis of power equipment (current, voltage).
Derived from	• 4SG#0018: J2289

4SG#0115: J2289 - Key-Off Parked Off Plug Operating (Tooling)	
Alias	J2289 - Key-Off Parked Off Plug Operating (Tooling)
Status	Addressed
Status Comment	EAST-ADL has concepts for annotation and modeling of static properties. Partial support in EPM is available but generic constraints and modes are lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support: the power requirement analysis in key-off mode.
Derived from	• 4SG#0018: J2289

4SG#0136: FMVSS No. 135 Analysis of brake system performance	
Alias	FMVSS No. 135 Analysis of brake system performance
Status	Addressed
Status Comment	EAST-ADL has concepts for annotation and modeling of static properties. Partial support in EPM is available but generic constraints and modes are lacking.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the analysis of power management and warning of brake system supply battery, to ensure brake operation, motor shutdown and warning at battery depleted state of charge.
Derived from	• 4SG#0071: FMVSS No. 135 Brake system

4SG#0140: ISO 8715 - Performance testing - Simulation tools for vehicle performance analysis	
Alias	ISO 8715 - Performance testing - Simulation tools for vehicle performance analysis
Status	Addressed

Status Comment	Addressed by behavioral analysis plug-ins. Part of Simulink and UPPAAL plug-ins.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the simulation of vehicle performance according to test condition and test case requirements.
Derived from	• 4SG#0019: ISO 8715

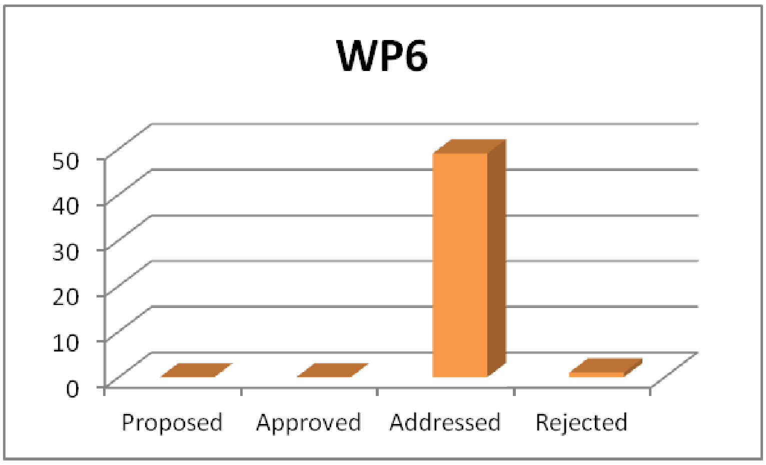
4SG#0144: ISO 8714 - Energy and range testing - Simulation tools for energy and range analysis	
Alias	ISO 8714 - Energy and range testing - Simulation tools
Status	Addressed
Status Comment	Addressed by behavioral analysis plug-ins. Part of Simulink and UPPAAL plug-ins.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the simulation of vehicle energy consumption and range according to test condition and test case requirements.
Derived from	• 4SG#0020: ISO 8714

4SG#0149: ISO 12045-2 - Lithium batteries - Simulation tool according to test procedure requirements	
Alias	ISO 12045-2 - Lithium batteries - Simulation tool according to test procedure requirements
Status	Addressed
Status Comment	Addressed by behavioral analysis plug-ins. Part of Simulink and UPPAAL plug-ins.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the simulation according to test case and test procedures requirements.
Derived from	• 4SG#0023: ISO 12405-2

4SG#0155: R13H Braking - Simulation tools to analyse brake compensation transients	
Alias	R13H Braking - Simulation tools to analyse brake compensation transients
Status	Addressed
Status Comment	Addressed by behavioral analysis plug-ins. Part of Simulink and UPPAAL plug-ins.
Type	«Tooling»
Priority	Medium
Description	Maenad tools should support the analysis (e.g. by simulation) of the compensation transients to verify that it is attained within the required time and value limits.
Derived from	• 4SG#0070: R13H Braking

7.7 WP6 - Case Study and Assessment

WP6 requirements are those that deal with validator application and project assessment.



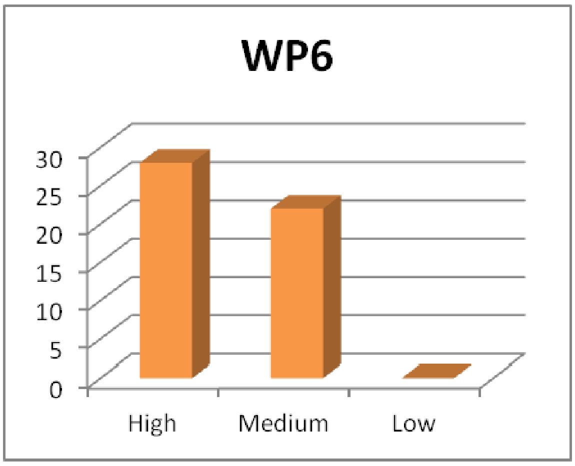


Figure 15: Status and priorities

4SG#0006: Case study	
Alias	O4-4/ Case study
Status	Addressed
Status Comment	Status of all derived requirements is “Addressed”.
Type	«Non-Function»
Priority	High
Description	The case study shall enable the demonstration of O4-4 objectives.
Derived from	• DOW#0019 O4-4
Refined by	• 4SG#0035 … 4SG#0038

4SG#0034: EV-technology related failures	
Alias	EV-specific issues/ EV-technology related failures
Status	Addressed
Status Comment	The integration with simulation tools enables the analysis of the failures of interest.
Type	«Non-Function»
Priority	High
Description	The project shall enable to perform behavioral simulation of EAST-ADL2 models covering the failures related to EV specific technology: inverter faults in connection with PM motors, wheel motors faults, regenerative braking failure or fading.
Derived from	• 4SG#0005: EV-specific issues • EV-technology related failures

4SG#0035: Documentation	
Alias	Case study/ Documentation

Status	Addressed
Status Comment	The documentation, including system interfaces, of design concepts has been provided by case study owner (like HVJB cabling) so to make possible the test bed realization.
Type	«Non-Function»
Priority	High
Description	The project documentation of design concepts and test bed case study shall be available, including system interfaces.
Derived from	• 4SG#0006: Case study

4SG#0036: Safety	
Alias	Case study/ Safety
Status	Addressed
Status Comment	The case study selected for the validation activity is a safety related system (EV propulsion management and gear selector).
Type	«Non-Function»
Priority	High
Description	The selected case study shall be significant in terms of safety concerns.
Derived from	• 4SG#0006: Case study

4SG#0037: EV-specific issues coverage	
Alias	Case study/ EV-specific issues coverage
Status	Addressed
Status Comment	The case study selected for the validation activity includes most of the EV-specific issues (systems selected: EV propulsion management, gear selector, …).
Type	«Non-Function»
Priority	High
Description	The selected design concepts should be significant in terms of almost all EV-specific issues.
Derived from	• 4SG#0006: Case study

4SG#0038: Best Practices	
Alias	Case study / Best Practices
Status	Addressed
Status Comment	The case study is performed according to the best practices, however it’s an example. It is not evident which EV standards are applied in a real project and to which extent.
Type	«Non-Function»
Priority	High
Description	The selected design concepts should be developed according to the best practices (e.g. relevant standards, simulation models, etc.).
Derived from	• 4SG#0006: Case study

CON#0004: Vehicle feature model in EAST-ADL	
Alias	Vehicle feature model in EAST-ADL

Status	Addressed
Status Comment	The vehicle feature model has been included in D6.1.2.
Type	«Functional»
Priority	High
Description	Provide a feature model on vehicle and system (analysis) level for profile and power mode management (system level done by ID4EV).
Derived from	

CON#0005. Profile mode and energy mode selection simulation	
Alias	Profile mode and energy mode selection simulation
Status	Addressed
Status Comment	The model simulation was finally done in Yakindu and a PC simulation. Modelica is not good at providing a simulation environment model for AUTOSAR components.
Type	«Functional»
Priority	High
Description	Provide a simulation model for a profile and mode selection logic (done within ID4EV project).
Derived from	• CON#0030: Simulation for AUTOSAR like systems

CON#0006: Simulation of energy consumer system	
Alias	Simulation of energy consumer system
Status	Addressed
Status Comment	The model simulation was finally done in Yakindu and a PC simulation. Modelica is not good at providing a simulation environment model for AUTOSAR components.
Type	«Functional»
Priority	High
Description	Provide a simulation model for an energy consumer system (mode manager clients) (initial model sample provided by ID4EV).
Derived from	• CON#0031: Simulation for AUTOSAR like systems

CON#0009 Annotate SysML/Modelica models with EAST-ADL stereotypes	
Alias	Remodel Modelica structure in EAST-ADL
Status	Addressed
Status Comment	In addition also an AUTOSAR model was created, with the same content as the EAST-ADL and SysML/EAST-ADL model.
Type	«Functional»
Priority	High
Description	Annotate SysML/Modelica models with EAST-ADL stereotypes. On base of a defined mapping between SysML and EAST-ADL, the SysML model of the profile and mode selection logic shall be annotated with EAST-ADL stereotypes. Structural as well as behavioral elements shall be annotated with EAST-ADL stereo-

	types.
Derived from	

CON#0013: Fault injection and verification in target environment	
Alias	Fault injection and verification in target environment
Status	Addressed
Status Comment	The test environment of the ID4EV project was used for these purposes.
Type	«Safety»
Priority	High
Description	VV case development, including fault injection and verification of model constraints in a HW simulation environment.
Derived from	• DOW#0017 O4-2

CON#0014: Fault injection and verification	
Alias	Fault injection and model verification
Status	Addressed
Status Comment	The simulation was done in Yakindu and/or a PC simulation. Test cases, including fault injections were developed, which verified the correct behavior of the system before it was deployed.
Type	«Safety»
Priority	High
Description	VV case development, including fault injection and verification of model constraints in a simulation environment for AUTOSAR like systems.
Derived from	• DOW#0017 O4-2

CON#0032: Safety Case in the context of a mode management	
Alias	Safety Case in the context of a mode management
Status	Rejected
Status Comment	A safety case related to range and mode management could not be found or was considered outside of its scope.
Type	«Safety»
Priority	Medium
Description	Define safety cases in the context of a global mode management. Comment: Should be related to identified safety cases in the maenad project.
Derived from	• CON#0016: Safety Case in the context of a mode management

CON#0033: Virtual integration	
Alias	Virtual integration
Status	Addressed
Status Comment	Modelica was not good at providing a simulation container for AUTOSAR like models. Global optimizations contradict to the modular system approach of AUTOSAR. During the project Modelica was replaced with Yakindu and a fully implemented PC simulation in C. The system was tested in this environment prior to deployment.

Type	«Use Case»
Priority	Medium
Description	Use Case virtual integration: A simulation environment can serve two purposes: the validation and integration on model level as well as the support of early integration of modules in the SW development phase. During the development of embedded systems target HW often is available only toward the end of a project. Early integration on model level helps to find logical errors in the model before the actual HW is available. It should be possible to use test cases for early/virtual integration as well as for the actual vehicle system.
Derived from	• CON#0021: Virtual integration

CON#1001: Adopt ID4EV Use Cases	
Alias	Adopt ID4EV Use Cases
Status	Addressed
Status Comment	In the functional design and the architecture use cases of ID4EV were considered.
Type	«Use Case»
Priority	Medium
Description	The Case Study shall adopt driving profiles of ID4EV project (Travel, City, Commuter, FUN, Limp Home) and related use cases.
Derived from	• CON#0001: Adopt ID4EV use cases

CON#1002: Resolve range deficit	
Alias	Resolve range deficit
Status	Addressed
Status Comment	The use case resolve range deficit was considered in the architecture and in timing analysis models.
Type	«Use Case»
Priority	Medium
Description	The ID4EV validator shall implement the use case "range problem solving for critical energy situations" of ID4EV project.
Derived from	• CON#0002: Resolve Range deficit

CON#2008: Transform Modes from A&D level into implementation level	
Alias	Profile and Mode manager in AUTOSAR
Status	Addressed
Status Comment	The same model was used for Analysis and Design and on Implementation level. A transformation was not required.
Type	«Use Case»
Priority	Medium
Description	Transformation step from design to implementation level: Transform the mode management defined on Analysis and Design level into the AUTOSAR mode management on implementation level.

Derived from	

CON#2011 Define constraints and enable verification of constraints	
Alias	Provide constraints in EAST-ADL
Status	Addressed
Status Comment	The verification of constraints requires access on variables in a runtime, a test environment and the ability to evaluate constraints in the test environment. Due to missing tool support, this could not be achieved.
Type	«Validation»
Priority	High
Description	EAST-ADL has to support the definition of model constraints for model verification. In order to verify constraints, constraints must be reformulated in a language, which can be evaluated. For some constraints (application logic), even an execution and thus model behavior is required. Candidate languages for the reformulation and evaluation of constraints are OCL or a simulation environment as Modelica. Within the scope of the project, it has to be evaluated, if such a verification of constraints is possible and samples shall be given.
Derived from	• CON#0011 Define constraints and enable verification of constraints

CON#2012 Define time constraints and enable verification of time constraints	
Alias	Provide time constraints in EAST-ADL (TADL)
Status	Addressed
Status Comment	Within the project an AUTOSAR model in ARtext and time constraints in ARtime were defined. It was not possible to verify these constraints, due to a missing toolchain from AUTOSAR into the simulation environment.
Type	«Validation»
Priority	High
Description	EAST-ADL supports the definition of timing of constraints by the inclusion of the TADL language. A verification of the TADL constraints shall be possible. It is an option to verify TADL constraints either by the use of timing analysis techniques as provided by languages as MARTE or AADL or model simulation techniques. Within the scope of the project, it has to be evaluated, if the verification of timing constraints on base of these techniques is possible and samples shall be given.
Derived from	• CON#0012 Define time constraints and enable verification of time constraints

CRF#0036 Fault injection	
Alias	case study / Fault injection
Status	Addressed
Status Comment	The propulsion system (+ gear selector) selected for the realization of the test bed allow the application of fault injection techniques.
Type	«Use Case»
Priority	High
Description	The selected test bed case study shall be sufficiently open, allowing the application of fault injection techniques.

Derived from	

CRF#0037 Completeness of architecture	
Alias	case study / Completeness of architecture
Status	Addressed
Status Comment	The propulsion system (+ gear selector), selected for the realization of the test bed, is an application near to the production.
Type	«Use Case»
Priority	High
Description	The selected test bed case study shall be an architecture as much as possible near to the production.
Derived from	

CRF#0038 Virtualization	
Alias	case study / Virtualization
Status	Addressed
Status Comment	Part of the propulsion system it is being virtualized (power inverter will be simulated).
Type	«Use Case»
Priority	High
Description	Shall be possible to "virtualize" some parts of the selected test bed case study.
Derived from	

CRF#0039 Completeness of design concept	
Alias	case study / Completeness of design concept
Status	Addressed
Status Comment	See D6.1.2.
Type	«Use Case»
Priority	High
Description	The architecture of the design concepts shall be well defined, enough to be able to perform the activities related to the validation of maenad approach (methods and tools).
Derived from	

CRF#0040 Documentation	
Alias	case study / Documentation
Status	Addressed
Status Comment	The documentation, including system interfaces, of design concepts has been provided by case study owner (like HVJB cabling) so to make possible the test bed realization.
Type	«Use Case»
Priority	High
Description	The project documentation, related to the test bed case study shall be available.

Derived from	

CRF#0042 Design concepts	
Alias	case study / Design concepts
Status	Addressed
Status Comment	Two different concepts for braking are available.
Type	«Use Case»
Priority	High
Description	At least two alternative design concepts shall be developed according to maenad methodology.
Derived from	

CRF#0043 ISO 26262 compliance	
Alias	case study / ISO 26262 compliance
Status	Addressed
Status Comment	A subset of ISO artifacts is represented of each of the demonstrators.
Type	«Safety»
Priority	High
Description	The selected test bed case study should be developed according to ISO 26262.
Derived from	

CRF#0063 Integration test	
Alias	Test Bed/Integration test
Status	Addressed
Status Comment	The physical test bed is available; it includes equipments to support testing activity. The test bed system can acquire the vehicle network and react on the base of signals acquired by it.
Type	«Validation»
Priority	High
Description	Test environment and equipments should support integration testing of distributed architecture.
Derived from	

CRF#0064 Back to back test	
Alias	Test Bed/Back to back test
Status	Addressed
Status Comment	Test bed hardware is ready for supporting back to back testing.
Type	«Validation»
Priority	High
Description	Test environment and equipments should support back to back testing techniques of executable models.

Derived from	

CRF#0065 Performance test	
Alias	Test Bed/Performance test
Status	Addressed
Status Comment	Test bed hardware and software is ready for supporting performance test.
Type	«Validation»
Priority	High
Description	Test environment and equipments should support performance test of the safety mechanism.
Derived from	

CRF#0066 Communication test	
Alias	Test Bed/Communication test
Status	Addressed
Status Comment	Test bed is defining for supporting runtime communication conformance test.
Type	«Validation»
Priority	High
Description	Test environment and equipments should provide support for runtime communication test between the subsystem under test and the rest of the vehicle.
Derived from	

CRF#0067 Fault injection	
Alias	Test Bed/Fault injection
Status	Addressed
Status Comment	Dedicated hardware in the test bed will support injection of faults like short to GND, short to power supply etc.
Type	«Validation»
Priority	High
Description	Test environment and equipments should provide means to inject faults at hardware level on subsystem boundary.
Derived from	

CRF#0068 Stress test	
Alias	Test Bed/Stress test
Status	Addressed
Status Comment	Test bed hardware and software is ready for supporting stress test.
Type	«Validation»
Priority	High
Description	Test environment and equipments should provide support for SUT analysis under high workload.

Derived from	

DOW#0101	
Alias	
Status	Addressed
Status Comment	Propulsion system and Regenerative Braking system have been modeled in MMW.
Type	«Tooling»
Priority	Medium
Description	The Complete model, tree view and diagrams (SystemModel) shall be modeled in MMW. Note: "model" means the case study. We shall show that it's possible to have the same model in different tools.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0102	
Alias	
Status	Addressed
Status Comment	Propulsion system and Regenerative Braking system have been modeled in Metaedit+.
Type	«Tooling»
Priority	Medium
Description	The Electrical Topology, tree view and diagram (HDA) shall be modeled in MMW, MetaEdit+.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0103	
Alias	
Status	Addressed
Status Comment	Propulsion system and Regenerative Braking system have been modeled in MMW.
Type	«Tooling»
Priority	Medium
Description	The Abstract Functional Architecture, tree view and diagram (FAA) shall be modeled in MMW.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0104	
Alias	
Status	Addressed
Status Comment	Addressed by EATOP editors. Tree view is part of EATOP and for diagram view several initiatives exist as to extension EATOP.
Type	«Tooling»

Priority	Medium
Description	The Functional Architecture, tree view and diagram (FDA) shall be modeled in MMW, EATOP ARTOP Editor.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0105	
Alias	
Status	Addressed
Status Comment	In MMW (Papyrus) all is addressed. In EATOP editor allocation (in simple form) and tree view are addressed; diagram is addressed in Conti EATOP editor on prototype level.
Type	«Tooling»
Priority	Medium
Description	The Function Allocation, tree view and diagram (DL) shall be modeled in MMW, EATOP ARTOP Editor.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0106	
Alias	
Status	Addressed
Status Comment	In MMW (Papyrus) all is addressed. In EATOP editor software architecture (FDA) and tree view are addressed; diagram is addressed in Conti EATOP editor on prototype level.
Type	«Tooling»
Priority	Medium
Description	The Software Architecture, tree view and diagram (AR SWCT) shall be modeled in MMW, EATOP ARTOP Editor.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0107	
Alias	
Status	Addressed
Status Comment	Completely addressed in MMW and SystemWeaver.
Type	«Tooling»
Priority	Medium
Description	The Complete model, tree view (SystemModel and extensions) shall be modeled in MMW, SystemWeaver.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0108	
Alias	
Status	Addressed

Status Comment	Addressed in EPM and MetaEdit+.
Type	«Tooling»
Priority	Medium
Description	The Error propagation analysis (FAA, DL) shall be modeled in MAW-Dependability plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0109	
Alias	
Status	Addressed
Status Comment	Addressed in EPM and MetaEdit+ with HipHops export.
Type	«Tooling»
Priority	Medium
Description	The FTA, FMEA (FAA, DL) shall be modeled in MAW-Dependability plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0110	
Alias	
Status	Addressed
Status Comment	Addressed by Papyrus/Qompass.
Type	«Tooling»
Priority	Medium
Description	The Timing analysis (DL) shall be modeled in MAW-Timing plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0111	
Alias	
Status	Addressed
Status Comment	Addressed by Papyrus AUTOSAR gateway.
Type	«Tooling»
Priority	Medium
Description	The SWC Synthesis (FDA-IL) shall be modeled in MAW-AR Gateway plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0112	
Alias	
Status	Addressed

Status Comment	See D5.2.1.
Type	«Tooling»
Priority	Medium
Description	The Simulink import-export (FAA, FDA) shall be modeled in MAW-Simulink plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0113	
Alias	
Status	Addressed
Status Comment	Addressed by OptiPal based on EPM. Timing is not covered, but energy consumption is considered instead.
Type	«Tooling»
Priority	Medium
Description	The Architecture optimization and configuration (DL) shall be modeled in MAW-Optimization/Variability/Timing/Dependability plug-in.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

DOW#0114	
Alias	
Status	Addressed
Status Comment	Addressed based on EAXML (see D6.1.3).
Type	«Tooling»
Priority	Medium
Description	The Model Exchange (SystemModel) shall be supported by MMW, EATOP ARTOP Editor, MetaEdit+ and SystemWeaver.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

TUB#0001 Variability Validation	
Alias	Variability Validation
Status	Addressed
Status Comment	The optimization case study (BBW) makes extensive use of variability to define the optimization space (both variability specification and configuration).
Type	«Validation»
Priority	High
Description	Validation of the variability concepts in EAST-ADL by the MAENAD case studies. This means at least one of the case studies should include system variability.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

UOH#0006 Safety_Analysis_Examples	
Alias	Safety_Analysis_Examples

Status	Addressed
Status Comment	See D6.1.3.
Type	«Validation»
Priority	Medium
Description	Example models/case studies are needed both to demonstrate the validity of the safety analysis concepts (such as ASIL decomposition and other ISO 26262 analyses) and to allow for testing of the relevant tools (e.g. HiP-HOPS). Therefore the different concepts (like ASILs) should be present in at least one validator, and each analysis tool should be employed in at least one validator.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

VTEC#0001 Fault injection	
Alias	
Status	Addressed
Status Comment	A test bench able to inject faults in physical prototypes has been realized. The test bench has been used for fault injection experiments on a physical prototype of an EV propulsion subsystem (see D6.1.3.).
Type	«Safety»
Priority	Medium
Description	Fault injection setup shall allow injection of faults in physical prototypes of a validator component.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

VTEC#0002 Fault injection	
Alias	
Status	Addressed
Status Comment	Behavioral model executable by rapid prototyping equipment can be enhanced to inject faults that simulate the effects of random HW failure, such as memory corruptions. The injection of the faults can be triggered by external HW or network signals (see D6.1.3.).
Type	«Safety»
Priority	Medium
Description	Fault injection setup shall allow injection of faults in models on Design level running on rapid prototyping equipment.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

7.8 WP7 - Dissemination and Exploitation

MAENAD requirements related to dissemination, exploitation and standardization are listed below.

TUB#0002 Documentation	
Alias	Documentation
Status	Addressed
Status Comment	White paper, tutorials, concept presentations, language documentation improvement, web-site, linked-in.
Type	«Non-Function»
Priority	High
Description	EAST-ADL shall become more accessible through tutorials, examples and other documentation material.
Derived from	• DOW#0007 O4: Verify, validate and explain the above capabilities in practical FEV design

7.9 Rejected Requirements

CRF#0041	
Alias	case study / validation possibility
Status	Rejected
Status Comment	Already covered by Objective 4 (DOW#0007). Therefore, this one is set to "rejected".
Type	«Non-Function»
Priority	High
Description	The selected case study shall enable validation of methodology and tools developed in maenad
Derived from	

CON#1008: Profile and Mode manager in AUTOSAR	
Alias	Profile and Mode manager in AUTOSAR
Status	Rejected
Status Comment	Obsolete, replaced by CON#2008
Type	«Concept»
Priority	Medium
Description	Provide a mapping of the profile and energy mode selection logic on an AUTOSAR mode manager
Derived from	