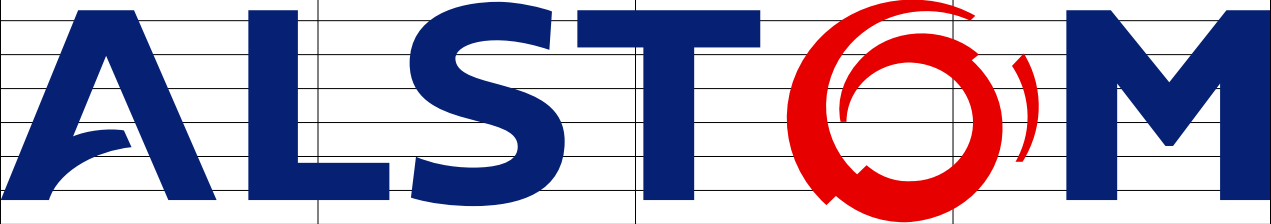


Project	DTRF Library		
Title	DTRF_150801		
Subtitle			
Type	Technical Purchase Specification		
State	Release		
Number			
Version	Baseline 2.0		
Language			
Date	2024-06-11		
Distribution Status			
DOORS Baseline	Baseline 2.0		
	Name / Role	Signature	Date
Author			
Reviewer			
Verifier			
Approver			
			

Introduction
The TPS forms the system design part of the contractual documentation and contains all requirements which can impact the design.
The following information and instructions should help the supplier to understand the document and complete the clause by clause in a way that will be beneficial for contract negotiations.
Format
The main body of the TPS are lines of text which are allocated into sections. Each line contains only a single requirement or piece of information.
There may be other Alstom documents which are referenced in the TPS. Alstom will ensure that a copy of these documents is provided either as an appendix or separately if the supplier does not already have them.
Some sections of the TPS may not be relevant for certain commodities in which case 'n/a' will be stated under the heading.
The 'Summary' tab allows to navigate to a specific chapter of the 'Content' Tab.
If applicable, a dedicated column displays the changes since the previous release.
Activities
Columns A to E are the core content, they should not be edited by the supplier.
The supplier is expected to provide a compliance status to Technical and Non-Technical requirements in the column 'Supplier Compliance Status'.
Any usefull information can be stored in the column 'Supplier Compliance Statement'.
All lines not identified as Technical or Non-Technical requirements, can be left without clause by clause.
Alstom reviews the compliance provided by the supplier in column 'Supplier Compliance Review Status'.
Column Headings
Displayed ID
Requirements ID, is to be provided by Alstom and shall never be modified.
Review Status
Maturity level of the requirement.
This status is provided by Alstom for information.
Object Type
Importance and legal status of requirement to the project.
<ul style="list-style-type: none"> • Technical Req: Any requirement impacting the design that the supplier shall comply to. • Non-Technical Req: Any deliverable or activity or non technical request that the supplier shall comply to. • Design: Description of design proposal. • Information: Where Alstom is providing context, but not requesting clause by clause from the supplier. • Heading: Structure the document, title of the chapter.
Requirements
States the requirements text that is to be fulfilled.
Planned Demonstration
States the type of evidence Alstom wishes the supplier to provide. A reference to a norm or standard may be provided for further information.
Linked Evidence
Lists the Evidence documents Alstom is expecting the supplier to provide to demonstrate compliance to the requirement.
If the supplier uses a template to provide the requested information, this is referenced here as well.

Supplier Compliance Status
To be provided by the supplier.
• Compliant: The provided solution will be 100% compliant to the stated requirement.
• Compliant with Comments: The requirement will be fulfilled but with an alternative design solution.
• Not Compliant: The requirement will not be fulfilled by the provided solution.
• Clarification Needed : The requirement needs to be clarified.
• Not Applicable: Should only be used on lines not flagged as Technical or Non-Technical requirements.
Supplier Compliance Statement
To be provided by the supplier.
In case of 'Compliant with Comments', 'Not Compliant', 'Clarification Needed', 'Not Applicable', the comments are to be stated in this column.
Alstom Review of Supplier Compliance
To be provided by Alstom.
• Accepted: Alstom accepts the 'Compliant with Comments' or 'Not Compliant' of the supplier.
• Rejected: Alstom can not accept the 'Compliant with Comments' or 'Not Compliant' and further discussions are needed to get an agreement.
• In Clarification: The supplier needs to provide additional data to allow the assessment from Alstom.
• To Review: Alstom review not performed yet.
• Compliant No Feedback Needed: Automatically set when the supplier is compliant and did not provide any comment.
Alstom Review Statement
To be provided by Alstom.
In case of 'Comply with Comments', the comments are to be stated in this column.

Section	Chapter
§ 1	<u>PURPOSE</u>
§ 2	<u>TERMS AND DEFINITIONS</u>
§ 3	<u>Applicable Standards</u>
§ 4	<u>SAFETY MANAGEMENT</u>
§ 4.1	<u>List of typical document and safety analyses</u>
§ 4.1.1	<u>Safety Plan</u>
§ 4.1.2	<u>Hazard Analysis</u>
§ 4.1.3	<u>Fmea / Fmeca</u>
§ 4.1.4	<u>Fault tree (safety)</u>
§ 4.1.5	<u>SAFETY MANAGEMENT FILE</u>
§ 4.2	<u>Activities before the contract signature</u>
§ 4.3	<u>Activities during development phase</u>
§ 4.4	<u>ACTIVITIES DURING THE OPERATION PHASE</u>
§ 5	<u>Typical SAFETY REQUIREMENTS</u>
§ 5.1	<u>HVAC</u>
§ 5.2	<u>Pantograph</u>
§ 5.3	<u>Doors</u>
§ 5.4	<u>Auxiliary battery</u>
§ 5.5	<u>Coupler</u>
§ 5.6	<u>Brakes</u>
§ 5.7	<u>Fire & Smoke Detection (and extinguishing) system (FSD)</u>
§ 5.8	<u>Master controller (MC)</u>
§ 5.9	<u>Toilet</u>
§ 5.10	<u>OTHER COMMODITIES</u>
§ 6	<u>SAFETY DELIVERABLES</u>

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
1			1 PURPOSE						
1 [2]			The purpose of this document is to describe the management requirements and the generic requirements related to Railway Safety.						
2			2 TERMS AND DEFINITIONS						
2 [143]			CGR: Critical Gate Review						
2 [144]			FAI: First Article Inspection						
2 [5]			FSD: Fire & Smoke Detection						
2 [6]			MC: Master Controller						
2 [145]			PGR: Preliminary Gate Review						
2 [146]			SGR: Specification Gate Review						
2 [7]			SIL: Safety Integrated Level.						
2 [8]			SRAC: Safety Related Application Conditions						
2 [9]			SSIL: Software Safety Integrated Level						
3			3 Applicable Standards						
3 [11]			EN50126-1 – [2017] - Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part1: Generic RAMS Process						
3 [181]			EN50126-2 – [2017] - Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part2: Systems Approach to Safety						
4			4 SAFETY MANAGEMENT						
4 [13]			The Supplier agrees to:						
4 [14]			• Supply a safe product,						
4 [15]			• Comply with EN50126 part 1 and 2 and the regulations applicable to the project,						
4 [16]			• Justify that the product satisfies specified safety requirements,						
4 [17]			• Be fully responsible for the performances of his system.						
4 [18]			• Inform Alstom about Safety Related Application Conditions (SRAC) and assumptions for which it is not responsible (related to storage, operation, inspection, etc.).						
4 [19]			The Supplier shall assist Alstom until the supplied product has been approved. It shall answer questions and comments made by Notified/Designated Body (NoBo/DeBo) and Independent Safety Assessor (ISA) if any and shall provide all requested studies and demonstrations.						
4.1			4.1 List of typical document and safety analyses						
4.1 [21]			The following documents are typical safety deliverables and these analyses will be carried out by the supplier (depending on project and product specificities, see §6 for details) and justify that the commitment on safety objectives will be achieved.						
4.1 [22]			Complementarily any specific requirements will be addressed in TPS.						
4.1.1			4.1.1 Safety Plan						
4.1.1 [24]			The Safety Plan is the set of Safety activities in accordance with the Safety Management System of the supplier that are applied throughout the product lifecycle to ensure that the Subsystems delivered to Alstom is safe and remains safe up to dismantlement.						

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
4.1.1 [25]			The purpose of a Safety Plan is to define the Safety requirements of the subsystem and the methods by which the safety level will be assessed and managed. This will detail resources, processes and safety management activities. It will be subject to on-going audit and verification and will contain clear safety objectives and deliverables. All safety deliverables and activities are subjected to a planning.						
4.1.1 [26]			If a Safety plan is produced, it will be sent for acceptance before the contract award.						
4.1.1 [27]			This document can be combined with a RAM Plan.						
4.1.2			4.1.2 Hazard Analysis						
4.1.2 [29]			The purpose of this analysis is to identify, characterize and classify the risks. Each Hazard related to the subsystem and the scope of the contract that is likely to occur during the life cycle of the subsystem will be assessed. In addition, the mitigation measures implemented to reach an acceptable risk level are identified and communicated according to the planning defined in the Safety plan.						
4.1.3			4.1.3 Fmea / Fmeca						
4.1.3 [31]			The Failure Modes and Effects Analysis (FMEA) is a systematic, formal procedure for analysing a subsystem to identify potential failure modes, and their causes and effects on the functionality of the subsystem.						
4.1.3 [32]			The FMECA (Failure Modes, Effects and Criticality Analysis) is an extension of the FMEA that includes a means of classifying failure modes by severity in order to give a priority to countermeasures.						
4.1.3 [33]			A summary of all mitigation measures impacting hazards resulting from the FMECA analysis is communicated to Alstom.						
4.1.3 [34]			Standard EN 60812 can be used as a reference.						
4.1.3 [35]			This document can be combined to include both safety and reliability point of views.						
4.1.4			4.1.4 Fault tree (safety)						
4.1.4 [37]			The aim of the fault tree is to demonstrate the proposed design achieves the specified safety requirements (quantitatively and qualitatively).						
4.1.4 [38]			Fault trees are built starting from the so-called "top event" (typically a function failure or a feared event). This backward logic allows identifying which combinations of component failures could give rise to that top event and then minimal cuts which would not be obviously identified.						
4.1.4 [39]			Assumptions and calculations rules shall be communicated with the supplied fault tree.						
4.1.4 [40]			Standard EN 61025 can be used as a reference.						
4.1.4 [41]			Other tools can be used (like Markov or petri net).						
4.1.5			4.1.5 SAFETY MANAGEMENT FILE						
4.1.5 [43]			The hazards identified, decisions made, solutions adopted and their implementation status are recorded in a management file or Hazard Log.						
4.1.5 [44]			This file compiles evidences on the implementation of safety requirements regarding all identified hazards, thus supporting the demonstration of completeness of the safety assurance activities						
4.1.5 [45]			All mitigation measures (or SRAC) under Alstom responsibility shall be extracted from this file (usually called hazard record).						
4.2			4.2 Activities before the contract signature						
4.2 [47]			A preliminary description of the safety performances of the supplied product is required (main hazards and provisions). Alstom will analyse these performances and will share them with the Supplier to finalise a common approach.						
4.2 [48]			The Supplier shall send the list of hazardous events considered for the design of his equipment / subsystem						
4.2 [49]			The Supplier shall send the description of all known prevention measures that are (will be) used and documented to guarantee a high level of safety. For example:						
4.2 [50]			• Application of recognised standards,						

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
4.2 [51]			• Carry out tests (send the validation plan),						
4.2 [52]			• Use subsystems / components certified by a reputable organisation,						
4.2 [53]			• Use subsystems / components proven in practice,						
4.2 [54]			• Respect qualitative requirements during the design (Redundancy – Fail Safe criterion, etc.),						
4.2 [55]			• Respect quantitative requirements during the design (for example frequency at which a feared event occurs)						
4.2 [56]			• Implementation of safety functions, or even evaluation of the capability of the subsystem / component to contribute performing a safety function (Safety Integrity Level "SIL" to be specified).						
4.2 [57]			The supplier shall send the mitigations (SRAC) and main assumptions under Alstom responsibility if any.						
4.2 [58]			A constructive response is expected (ie: with exchange of information) during the call for bids phase. In case of a compliance statement without relevant information provided, Alstom will consider that the Supplier has made a commitment to comply with any safety requirements defined during the system requirements allocation phase (neither extended times nor increased costs will be accepted).						
4.2 [59]			The Supplier shall inform Alstom if it considers necessary to make a common safety study (for example this would be justified if integration of the component / subsystem is complex, if interfaces are potentially critical from a safety point of view).						
4.3			4.3 Activities during development phase						
4.3 [182]			The Supplier shall communicate any new SRAC (all the SRAC are expected before contract award, refer to §4.2) as soon as possible to get general acceptance from Alstom. The final acceptance of the SRAC related to maintenance is communicated once accepted by the O&M.						
4.3 [61]			The Supplier shall write a safety case that will contain all demonstrations to prove that the product is safe. At minimum it is required a statement that the system delivered is safe (then comply with the safety requirements defined by Alstom and Regulation if any). As example, the safety case shall include the following:						
4.3 [62]			• A list of residual risks that repeats all requirements to be respected by other to achieve and maintain the high safety level expected. These SRAC may relate to:						
4.3 [63]			• Storage,						
4.3 [64]			• Integration,						
4.3 [65]			• Commissioning,						
4.3 [66]			• Operation,						
4.3 [67]			• Tests and inspections to be made,						
4.3 [68]			• Maintenance						
4.3 [69]			• Restrictions of use.						
4.3 [147]			The mitigation measures refer to exported safety requirements coming from safety analysis if any. The consolidated list provided by the Supplier can call a specific section of an existing document.						
4.3 [183]			When no SRAC are communicated, a statement shall be written to prevent any misunderstanding.						
4.3 [70]			• Documents describing that all defined prevention measures have been correctly implemented:						
4.3 [71]			• Evidence of conformity with recognised standards,						
4.3 [72]			• Certificates for subsystems / components,						
4.3 [73]			• Justification file based on operating experience						
4.3 [74]			• Evidence of conformity with defined qualitative requirements,						

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement				
4.3 [75]			• Evidence that quantitative requirements are respected and therefore that:										
4.3 [76]			• Intervals between inspections (interval between two tests) used for the calculation are justified and are in agreement with the maintenance documentation written by the Supplier (for example a 24h test interval may be selected for a component that is tested automatically when the train is powered up).										
4.3 [77]			• The source of failure rates used is defined (operating experience, expert opinion, database).										
4.3 [78]			• Common cause failures (hardware and software) are evaluated.										
4.3 [79]			• Justification of compliance of the development to any Safety function relying on software shall be provided (typically compliance to EN50128).										
4.3 [80]			• Assumptions used for the study are listed.										
4.3 [81]			• Evidence that the instrumented safety functions achieve the defined safety integrity level, or even that the subsystem / component is capable of contributing to performing a safety function.										
4.3 [82]			• The list of identified dangerous failure modes,										
4.3 [83]			• etc.										
4.3 [84]			The safety case is a way to formalize the Supplier commitment on Safety. The supplier is responsible to deliver a safe product compliant with regulation and all the safety tasks to be performed to operate and maintain it safe over its life expectancy.										
4.3 [85]			The Supplier is responsible for the technical definition of his supply (configuration management and upgrade management). It shall define the configuration/version of the system under consideration to which the safety case applies and make sure that components and software critical for safety are traceable.										
4.3 [86]			A preliminary safety case shall be sent before the start-up of series production. This report must be accepted by Alstom and it is compulsory for validation of the First Article Inspection (FAI).										
4.3 [148]			Prior to the acceptance of series of equipment the safety case shall have been reviewed by Alstom. There shall be no blocking open point beside the ones related to activities planned after the acceptance such as test to be carried out on the train etc....Once the remaining validation activities are performed, the final version of the safety case will be issued not later than 1 month after and agreed by both Parties.										
4.4			4.4 ACTIVITIES DURING THE OPERATION PHASE										
4.4 [89]			The Supplier agrees that throughout the life of the component it shall:										
4.4 [90]			• Analyse any failures critical for safety										
4.4 [91]			• If necessary, recall and modify components / subsystems in operation										
4.4 [92]			• Update predictive studies carried out and send the updated safety file to Alstom (as necessary).										
5			5 Typical SAFETY REQUIREMENTS										
5 [94]			The Safety requirements are formalized and agreed prior contract award. On case by case basis (e.g. when a common safety study is needed), a specific action plan can be defined.										
5 [95]			Safety demonstrations provided by the supplier will be reviewed and action closed when accepted by Alstom. The mitigations shall be clearly documented and performances maintained over the life of the product.										
5 [96]			Interface with others equipment and associated safety requirements will be defined further and before contract award if any.										
5 [97]			The specific functional safety requirements and targets are defined in the relevant TPS.										
5.1			5.1 HVAC										
5.1 [99]			<table border="1"> <thead> <tr> <th>FSR</th> <th>Functional Safety Requirements</th> </tr> </thead> <tbody> <tr> <td>FSR01</td> <td>Hazard: Asphyxia due to fire on board Feared Event: Fire start or a smoke release from the HVAC [FN] Return of Experience stating the occurrence is improbable is recommended</td> </tr> </tbody> </table>	FSR	Functional Safety Requirements	FSR01	Hazard: Asphyxia due to fire on board Feared Event: Fire start or a smoke release from the HVAC [FN] Return of Experience stating the occurrence is improbable is recommended						
FSR	Functional Safety Requirements												
FSR01	Hazard: Asphyxia due to fire on board Feared Event: Fire start or a smoke release from the HVAC [FN] Return of Experience stating the occurrence is improbable is recommended												

			FSR	Functional Safety Requirements						
Displayed ID	Review Status	Object Type	FSR01	Hazard: Asphyxia due to fire on board Feared Event: Fire start or a smoke release from the HVAC Requirements [FN] Return of Experience stating the occurrence is improbable is recommended.	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.1 [100]			FSR	Functional Safety Requirements						
			FSR02	Hazard: Projectile/ pressure wave Feared Event: HVAC explosion [FN] Return of Experience stating the occurrence is improbable is recommended.						
5.1 [101]			FSR	Functional Safety Requirements						
			FSR03	Hazard: Electrocuton Note: It shall cover all operations phases. Feared Event: HVAC failures leading to electrocuton (Voltage >=400 V) [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
5.1 [102]			FSR	Functional Safety Requirements						
			FSR04	Hazard: Intoxication/ Pollution Feared Event: Failures leading to refrigerant leak outside the HVAC unit (apply when refrigerant is toxic) [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is improbable is recommended.						
5.1 [103]			FSR	Functional Safety Requirements						
			FSR05	Hazard: Collision/projectile Feared Event: Failures leading to gauge fouling or fall/ projection of HVAC parts [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
5.2			5.2 Pantograph							
5.2 [105]			FSR	Functional Safety Requirements						
			FSR01	Hazard: not able to cut-off or isolate HV supply Feared Event: Not able to lower the pantograph given order is sent						
5.2 [106]			FSR	Functional Safety Requirements						
			FSR02	Hazard: Catenary rupture Feared Event: No adjustment in height of the pantograph leading to damage of the overhead line by arcing (dampers failure or others)						
5.2 [107]			FSR	Functional Safety Requirements						
			FSR03	Hazard: Collision/projectile Feared Event: Failures leading to gauge fouling or fall/projection of Pantograph parts [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
5.2 [108]			FSR	Functional Safety Requirements						
			FSR04	Calculation note to demonstrate fixations are adequate and redundant.						
5.2 [109]			FSR	Functional Safety Requirements						
			FSR05	To demonstrate the effort needed to rise the pantograph is higher than the air pressure while running (both directions and taking into account worst consequences)						
5.3			5.3 Doors							

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.3 [111]			FSR	Functional Safety Requirements					
			FSR01	Hazard: People falling of train due to wrong side opening Functional Requirement: To not allow door wrong side opening (up to SIL4 at Train level)					
5.3 [112]			FSR	Functional Safety Requirements					
			FSR02	Hazard: People falling of train in operation or Collision due to fouling of the gauge Functional Requirement: To maintain door/step closed when running (up to SIL4 at Train level)					
5.3 [113]			FSR	Functional Safety Requirements					
			FSR03	Hazard: People falling of train in operation Feared event: Loss of door closing effort allowing opening [FN] Qualitative demonstration accepted.					
5.3 [114]			FSR	Functional Safety Requirements					
			FSR04	Hazard: People falling of train in operation Functional Requirement: To prevent the door opening in case of emergency handle actuation when train is in motion. (up to SIL2 at Train level)					
5.3 [115]			FSR	Functional Safety Requirements					
			FSR05	Hazard: People falling of train at start-up or Collision due to fouling of the gauge Functional Requirement: To not allow start-up when at least one door/step is not closed & locked (up to SIL4 at Train level)					
5.3 [116]			FSR	Functional Safety Requirements					
			FSR06	Hazard: Departure of the train with something [FN] or someone gripped by doors Functional Requirement: To not start with a passenger trapped during closing/opening phase (up to SIL4 at Train level) [FN] minimum size of the object specified in TPS					
5.3 [117]			FSR	Functional Safety Requirements					
			FSR07	Hazard: Door locked closed (no emergency escape possible) Functional Requirement: To open mechanically a door when door manual opening is required (up to SIL2 at Train level)					
5.3 [118]			FSR	Functional Safety Requirements					
			FSR08	Hazard: Fall of passengers from vehicle on track by the door window Qualitative requirement : Compliance to UIC 566 §2.1.2 (for UIC compliant rolling-stock)					
5.3 [119]			FSR	Functional Safety Requirements					
			FSR09	Hazard: Departure of the train with something or someone gripped by doors Qualitative requirement : Compliance to EN14752					
5.3 [120]			FSR	Functional Safety Requirements					
			FSR10	Hazard: People falling of train Functional Requirement: Closed step wrongly detected as open and allows the door to open (up to SIL2 at Train level)					
5.4			5.4 Auxiliary battery						
5.4 [149]			The following requirements apply to the low-voltage batteries (ie to supply auxiliary equipment)						

Displayed ID	Review Status	Object Type	Requirements	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement				
5.4 [122]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety Requirements</th> </tr> <tr> <td>FSR01</td> <td>Hazard: Projectile/pressure wave Feared event: Projection of mechanical parts or fluid of the battery due to explosion of the battery (coming from internal failure causes) [FN] Return of Experience and recognized standard compliance (eg EN60529) stating the occurrence is improbable is recommended.</td> </tr> </table>	FSR	Functional Safety Requirements	FSR01	Hazard: Projectile/pressure wave Feared event: Projection of mechanical parts or fluid of the battery due to explosion of the battery (coming from internal failure causes) [FN] Return of Experience and recognized standard compliance (eg EN60529) stating the occurrence is improbable is recommended.						
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5.4 [123]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety Requirements</th> </tr> <tr> <td>FSR02</td> <td>Hazard: Asphyxia due to fire on board Feared event: Fire start or smoke release from Battery</td> </tr> </table>	FSR	Functional Safety Requirements	FSR02	Hazard: Asphyxia due to fire on board Feared event: Fire start or smoke release from Battery						
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FSR	Functional Safety Requirements												
FSR03	Hazard: Electrocuttion Feared Event: Battery failure leading to electrocution Note: It shall cover all operations phases.												
5.4 [125]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety Requirements</th> </tr> <tr> <td>FSR04</td> <td>Hazard: Projectile/pressure wave Feared event: Presence of H2 gas cloud having a concentration between LEL (4%vol) and SEL (75%vol) or other explosive or toxic gas clouds. Calculations of necessary ventilation for battery boxes based on EN50272-2 or equivalent according to Boost charge current (Igas boost) and assuming an overvoltage of xxxV (worst ambient conditions to be taken) Note: Exported safety constraints to limit potential ignition sources and regarding battery ventilation box outside Supplier scope shall be shared with Alstom if any.</td> </tr> </table>	FSR	Functional Safety Requirements	FSR04	Hazard: Projectile/pressure wave Feared event: Presence of H2 gas cloud having a concentration between LEL (4%vol) and SEL (75%vol) or other explosive or toxic gas clouds. Calculations of necessary ventilation for battery boxes based on EN50272-2 or equivalent according to Boost charge current (Igas boost) and assuming an overvoltage of xxxV (worst ambient conditions to be taken) Note: Exported safety constraints to limit potential ignition sources and regarding battery ventilation box outside Supplier scope shall be shared with Alstom if any.						
FSR	Functional Safety Requirements												
FSR04	Hazard: Projectile/pressure wave Feared event: Presence of H2 gas cloud having a concentration between LEL (4%vol) and SEL (75%vol) or other explosive or toxic gas clouds. Calculations of necessary ventilation for battery boxes based on EN50272-2 or equivalent according to Boost charge current (Igas boost) and assuming an overvoltage of xxxV (worst ambient conditions to be taken) Note: Exported safety constraints to limit potential ignition sources and regarding battery ventilation box outside Supplier scope shall be shared with Alstom if any.												
5.4 [126]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety Requirements</th> </tr> <tr> <td>FSR05</td> <td>Hazard: Collision/projectile Feared event: Failures leading to gauge fouling or fall/ projection of Battery parts [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.</td> </tr> </table>	FSR	Functional Safety Requirements	FSR05	Hazard: Collision/projectile Feared event: Failures leading to gauge fouling or fall/ projection of Battery parts [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
FSR	Functional Safety Requirements												
FSR05	Hazard: Collision/projectile Feared event: Failures leading to gauge fouling or fall/ projection of Battery parts [FN] Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.												
5.5			5.5 Coupler										
5.5 [151]			Generic Functional Safety Requirements for <u>automatic</u> or <u>semi-permanent</u> couplers:										
5.5 [152]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety requirement</th> </tr> <tr> <td>FSR01as</td> <td>Hazard: Collision/projectile Feared event: failures leading to gauge fouling or fall/ projec parts [FN] Qualitative demonstration relying on recognized standard compliance occurrence is improbable is recommended</td> </tr> </table>	FSR	Functional Safety requirement	FSR01as	Hazard: Collision/projectile Feared event: failures leading to gauge fouling or fall/ projec parts [FN] Qualitative demonstration relying on recognized standard compliance occurrence is improbable is recommended						
FSR	Functional Safety requirement												
FSR01as	Hazard: Collision/projectile Feared event: failures leading to gauge fouling or fall/ projec parts [FN] Qualitative demonstration relying on recognized standard compliance occurrence is improbable is recommended												
5.5 [153]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety requirement</th> </tr> <tr> <td>FSR02as</td> <td>Calculation note to demonstrate fixations on carbody are ad redundant (when applicable)</td> </tr> </table>	FSR	Functional Safety requirement	FSR02as	Calculation note to demonstrate fixations on carbody are ad redundant (when applicable)						
FSR	Functional Safety requirement												
FSR02as	Calculation note to demonstrate fixations on carbody are ad redundant (when applicable)												
5.5 [154]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety requirement</th> </tr> <tr> <td>FSR03as</td> <td>Mechanical tests compliant with the TPS requirements</td> </tr> </table>	FSR	Functional Safety requirement	FSR03as	Mechanical tests compliant with the TPS requirements						
FSR	Functional Safety requirement												
FSR03as	Mechanical tests compliant with the TPS requirements												
5.5 [155]			Generic Functional Safety Requirements for <u>automatic</u> couplers:										
5.5 [156]			<table border="1"> <tr> <th>FSR</th> <th>Functional Safety requirement</th> </tr> <tr> <td>FSR01a</td> <td>Hazard: Derailment/Collision Feared event: Undue automatic coupler uncoupling [FN] Qualitative demonstration stating the occurrence is incredible is acceptable</td> </tr> </table>	FSR	Functional Safety requirement	FSR01a	Hazard: Derailment/Collision Feared event: Undue automatic coupler uncoupling [FN] Qualitative demonstration stating the occurrence is incredible is acceptable						
FSR	Functional Safety requirement												
FSR01a	Hazard: Derailment/Collision Feared event: Undue automatic coupler uncoupling [FN] Qualitative demonstration stating the occurrence is incredible is acceptable												

Displayed ID	Review Status	Object Type	FSR	Functional Safety requirement	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.5 [157]			FSR01a	Hazard: Derailment/Collision Feared event: Undue automatic uncoupling (FN) Qualitative demonstration stating the occurrence is incredible is accepted						
			FSR	Functional Safety requirement						
			FSR02a	Hazard: loss of brake performances potential for collision/derailment Feared Event: Untimely complete or partial closure of the Brake Pipe and/or Main Pipe in a coupled status (when applicable) (FN) Qualitative demonstration stating the occurrence is incredible is accepted						
5.5 [158]			FSR	Functional Safety requirement						
			FSR03a	Hazard: Collision Feared Event: Untimely uncoupling with a complete or partial closure of the Brake Pipe (when applicable) (FN) Qualitative demonstration stating the occurrence is improbable is accepted						
5.5 [159]			FSR	Functional Safety requirement						
			FSR04a	Hazard: loss of safety function relaying on train line Feared Event : Untimely grounding of a low voltage train line or uncoupled status) (When applicable) (FN) Qualitative demonstration stating the occurrence is improbable is accepted						
5.5 [160]			FSR	Functional Safety requirement						
			FSR05a	Hazard: loss of safety function relaying on train line Feared Event : Untimely feeding of a low voltage train line energized low voltage line (in coupled or uncoupled status) (when applicable)						
5.5 [161]			FSR	Functional Safety requirement						
			FSR06a	Coupler compliant with EN60352 and IEC 61373 (to confirm of electrical connections in line with FSR04 & FSR05) Note: Discrepancy with IEC 61373 test requirements will be managed through any will be added						
5.5 [162]			Generic Functional Safety Requirements for semi-permanent couplers:							
5.5 [163]			FSR	Functional Safety requirement						
			FSR01s	Hazard: Derailment/Collision Feared event: Undue permanent or semi-permanent uncoupling (FN) Qualitative demonstration stating the occurrence is incredible is accepted						
5.6			5.6 Brakes							
5.6 [165]			The defined failure modes consider the "full-scope" of brake system including brake control, air supply and bogie brake).							
5.6 [166]			FSR	Functional Safety requirement						
			FSR01	Hazard: Derailment/Collision Feared event: Lost/Impaired Emergency brake at train level (leading to the non-respect of stopping distances or emergency brake minimum deceleration as specified in the TPS/LPA)						
5.6 [167]			FSR	Functional Safety requirement						
			FSR02	Hazard: Derailment/Collision Safety Requirement: Every single failure degrading the nominal emergency braking performance at train level (as specified in the TPS/LPA). All such failures shall be detected)						
5.6 [168]			FSR	Functional Safety requirement						
			FSR03	Hazard: Derailment/fire Feared event: Undue undetected Brake (all types of brake) application while running (up to 1E-9/h at Train level)						

		FSR	Functional Safety requirement							
Displayed ID	Review Status	Object Type	FSR03	Hazard: Derailment/fire Feared event: Undue undetected Brake (all types of brake) application while running (up to 1E-9/h at Train level)	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.6 [169]			FSR	Functional Safety requirement						
			FSR04	Hazard: Derailment/Collision Functional requirement: WSP function failure jeopardizing the pneumatic braking performance at train level (leading to the non-respect of stopping distances or emergency brake minimum deceleration as specified in the TPS/LPA) Note 1: A systematic WSP regulation failure properly mitigated after a defined temporisation by the watchdog will be considered in the emergency brake performance calculation. Note 2: Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
5.6 [170]			FSR	Functional Safety requirement						
			FSR05	Hazard: Collision due to drift of the train Feared event: Loss of parking brake performance (as specified in the TPS) leading to drift of the train (up to 1E-9/h at Train level)						
5.6 [171]			FSR	Functional Safety requirement						
			FSR06	Hazard: Collision due to drift of the train Feared event: Undetected parking brake mechanical release per parking brake unit when human action is needed to reset/ unlock the parking brake						
5.6 [172]			FSR	Functional Safety requirement						
			FSR07	Hazard: Passenger injuries Excessive jerk (as specified in the TPS)						
5.6 [173]			FSR	Functional Safety requirement						
			FSR08	Hazard: Collision/projectile Feared event: failures leading to gauge fouling or fall/projection of parts * Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.						
5.6 [174]			FSR	Functional Safety requirement						
			FSR09	Hazard: People falling of train at start-up due to train drift Functional requirement: To apply and maintain holding brake during passenger exchange (up to 1E-7/h at Train level)						
5.6 [175]			FSR	Functional Safety requirement						
			FSR10	Hazard: People falling of train Functional requirement: To provide the standstill/zero velocity information (up to 1E-7/h/SIL2)						
5.6 [176]			FSR	Functional Safety requirement						
			FSR11	Hazard: Derailment/Collision Feared event: Undetected loss of pressure in the main pipe below the minimum threshold (as stated in the TPS). (Up to 1E-7/h at train level)						
5.7			5.7 Fire & Smoke Detection (and extinguishing) system (FSD)							
5.7 [185]			FSR	Functional Safety requirement						
			FSR01	Hazard: Asphyxia due to fire on board Functional Requirement: To detect fire in hazardous local communicate the information through a LV output de-energ (FN2). [FN1] : Typically, MV/HV cubicles (like traction box, Main Transformer) or be protected are specified in TPS. [FN2] : when required, software developed in accordance with SIL2 requirement of EN50657 and hardware in accordance with SIL2 requirement of EN50121 Compliance to EN50121 also required.						

Displayed ID	Review Status	Object Type	FSR	Functional Safety requirement	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.7 [186]			FSR01	Hazard: Asphyxia due to fire on board Functional Requirement: To detect fire in hazardous local communicate the information through a LV output de-energ (FN2). [FN1] : Typically, MV/HV cubicles (like traction box, Main Transformer) or p be protected are specified in TPS. Requirements [FN2] : when required, software developed in accordance with SIL2 require EN50657 and hardware in accordance with SIL2 requirement of EN50121 also required. Functional Safety requirement						
			FSR02	Hazard: Asphyxia due to fire on board Functional Requirement: To release firefighting agent in de when an order [FN] is received (up to SIL2). [FN] : type of order is specified in TPS (like LV input energized). Functional Safety requirement						
5.7 [187]			FSR	Functional Safety requirement						
			FSR02a [FN1]	Hazard: Cancerogenic or toxic firefighting agent Feared event: Untimely release [FN2] of firefighting agent v person is foreseen (like during maintenance). [FN1] : Applicable when the safety requirement FSR02 applies and the fire (water mist being recommended). [FN2] : Release shall be prevented when the train is not in commercial ventilation requirement defined to ensure the access is safe after a release. [FN3] : Qualitative demonstration accepted. Functional Safety requirement						
5.7 [188]			FSR03	Hazard: various Qualitative requirement: Compliance with IEC613 environmental conditions defined for the project (e.g. tests in EN60068 performed) and EN45545 [FN] [FN] : Environmental conditions specified in TPS if any Functional Safety requirement						
			Master Controller (MC)							
5.8 [190]			FSR	Functional Safety requirement						
			FSR01	Feared Events to be demonstrated for the complete system (control lever, transfer mechanism and switch): - Contact [FN1] NO blocked closed when it is released by - Contact [FN1] NO blocked opened when it is activated by - Contact [FN1] NC blocked open when it is released by the - Contact [FN1] NC blocked closed when it is activated by Remarks : - evaluation per contact, whatever the function performed - Interlocking between contacts if any shall be documented - Interlocking between sub-systems [FN2] if any shall be documented. [FN1] Applies for all contacts of Master Controller including Speed Direction, Key Switch, Mode Selector and Running Direction. Functional Safety requirement						
5.8 [191]			FSR02	Feared Event: In the absence of cab Key, a contact ⁽¹⁾ not in e [FN] Qualitative demonstration stating that the occurrence is improbable ca Functional Safety requirement						
			FSR	Functional Safety requirement						
5.8 [192]			FSR03	Hazard: Deadman not detected Functional Requirement: To release the Deadman acknowledgement Input: no more Driver acknowledgement Treatment: when Deadman acknowledgement is released [FN from E/PE [FN2] is set at 0 (de-energized) [FN1] All the conditions used to acknowledge the Deadman shall be considered [FN2] Electronic/Programmable Electronic [FN3] software developed in accordance with SIL2 requirements of EN50128 Hardware in accordance with SIL2 requirement of EN50129 or equivalent. or EN50121 also required. Functional Safety requirement						
			FSR04	Hazard: Unwanted traction/brake order or effort requested greater than the position of the Traction/Brake Handle. Functional Requirement: To communicate the traction/brake the position of the Traction/Brake Handle. Input: Position of the Traction/Brake Handle Treatment: Given the position of the Traction/Brake Handle, t E/PE [FN1] is set as expected (Considering the redundancy if [FN1] Electronic/Programmable Electronic [FN2] software developed in accordance with Basic Integrity requirements of EN50657. Functional Safety requirement						

Displayed ID	Review Status	Object Type	FSR	Functional Safety requirement	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement
5.8 [194]			FSR04	Hazard: Unwanted traction/brake order or effort requested greater than the c Functional Requirement: To communicate the traction/brake the position of the Traction/Brake Handle Input: Position of the Traction/Brake Handle Treatment: Given the position of the Traction/Brake Handle, t E/PE [FN1] is set as expected (considering the redundancy if [FN1] Electronic/Programmable Electronic [FN2] software developed in accordance with basic integrity requirements of EN50657.						
				Functional Safety requirement						
5.8 [195]			FSR05	Master Controller compliant with IEC61373, EN50155 and environmental conditions defined for the project (e.g. tests in accordance with EN60068 performed).						
			FSR	Functional Safety requirement						
			FSR06	Hazard: Emergency Brake order released Qualitative requirement: The emergency braking position is notched and stable.						
5.9			5.9 Toilet							
5.9 [199]			The Toilet supplier shall document that any credible hazard due to its scope of supply is well mitigated. At least the following hazards shall be analyzed:							
5.9 [200]			FSR	Functional Safety requirement						
			FSR01	Hazard: Asphyxia due to fire on board Feared Event: smoke release from the Toilet not detected [FN [FN1] Qualitative demonstration stating the occurrence is improbable is rec [FN2] On project basis detection relying on smoke detector installed and p supply						
5.9 [201]			FSR	Functional Safety requirement						
			FSR02	Hazard: Electrocutation Note: It shall cover all operations phases (like maintenance). Feared Event: Contact with part under voltage leading to elec [FN] Qualitative demonstration relying on recognized standard compl occurrence is improbable is recommended.						
5.9 [202]			FSR	Functional Safety requirement						
			FSR03	Hazard: Fall of parts Feared Event: Failures leading to fall of Toilet parts [FN] Qualitative demonstration relying on safety cable stating the occ recommended.						
5.9 [203]			FSR	Functional Safety requirement						
			FSR04	Hazard: no emergency escape (considering also person with reduced mobility outside) Feared Event: Door failure leading to jeopardize emergency e [FN] Qualitative demonstration relying on recognized standard compl occurrence is improbable is recommended.						
5.9 [204]			FSR	Functional Safety requirement						
			FSR05	Hazard: Presence of sharp objects or pinch points Feared Event: Passenger contact with a sharp object or pind when door closing) [FN] Pinch points as defined in EN12221-2:95.3.1.1 to 95.3.3 or those specifi						
5.9 [205]			FSR	Functional Safety requirement						
			FSR06 [FN2]	Hazard: Information not transmitted to the driver/ train crew Feared Event: Passenger unable to call for help [FN1] Qualitative demonstration stating the occurrence is improbable is ac [FN2] Applicable when required by regulation (TSI DRM)						
5.9 [206]			FSR	Functional Safety requirement						
			FSR07	Hazard: various Qualitative requirement: Compliance with IEC61373, EN environmental conditions defined for the project (e.g. tests i EN60068 performed) and EN45545 [FN] [FN] : EN45545 requirements are specified in TPS if any						

FSR	Functional Safety requirement
	Hazard: various
FSR07	Qualitative requirement: Compliance with IEC61373, EN environmental conditions defined for the project (e.g. tests i requirements EN60068 performed) and EN45545 [FN1]
	[FN1] : EN45545 requirements are specified in TPS Italy
Functional Safety Requirements	
FSR08	Hazard: Drinking water contamination [FN2] [FN3] [FN4] Feared Event: Drinking water contamination due to improper kind of failure [FN1] Qualitative demonstration relying on recognized standards com qualified material used and manufacturing/storage prevent contamin occurrence is incredible is expected [FN2] : Applies when drinkable water is specified. If not, the hazard appropriate safety warning. [FN3] - Contamination from a passenger is excluded [FN4] - Contamination from a passenger is excluded
	OTHER COMMODITIES The commodities are defined and shared (like cleaning requ constraints)

Displayed ID	Review Status	Object Type	Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement	
5.9 [207]									
5.10									
5.10 [128]			For other commodities not specifically detailed in the current revision of the present document the functional safety requirements will be defined in the relevant TPS.						
6			6 SAFETY DELIVERABLES						
6 [130]			The below list of safety deliverables is the by default list to be applied for each commodity. It can be adjusted based on project and product specificities. In case of specific requirements this shall be stated in the corresponding TPS.						
6 [131]			Ref	Subsystem Safety Typical deliverables list	BRAKES	DOORS	HVAC	COUPLER	BATTERY
			1	Safety Plan	M	M	R	-	-
6 [132]			M : Mandatory HR : Highly Recommended R : Recommended	Subsystem Safety Typical deliverables list	BRAKES	DOORS	HVAC	COUPLER	BATTERY
			2	Hazard Analysis [FN4]	M	M	M	M	M
6 [133]			M : Mandatory HR : Highly Recommended R : Recommended	Subsystem Safety Typical deliverables list	BRAKES	DOORS	HVAC	COUPLER	BATTERY
			[FN3]: Applies when the gas used for extinguishment is toxic safety [FN4]: Hazard Analysis is under the supplier responsibility. When not requested, that means Alstom required only the summary in the Safety Case (including SRAC if any). [FN5]						
6 [134]			M : Mandatory HR : Highly Recommended R : Recommended	Subsystem Safety Typical deliverables list	BRAKES	DOORS	HVAC	COUPLER	BATTERY
			[FN5]: Safety Management file (Hazard Log) is under the supplier responsibility. That means Alstom requires only the status of the safety requirements coming from the supplier safety studies and those defined by Alstom in the Safety Case (including SRAC if any). [FN6]						
6 [135]			M : Mandatory HR : Highly Recommended R : Recommended	Subsystem Safety Typical deliverables list	BRAKES	DOORS	HVAC	COUPLER	BATTERY
			5	Safety Demonstrations (like FTA)	M	M	M when applicable [FN1]	M when applicable [FN1]	M when applicable [FN1]

M : Mandatory
HR : Highly Recommended
R : Recommended

[FN1]: When a demonstration of a feared event or a functional failure rate specified relies on the combination of failures (complementary with single failure analysis FMEA/FMECA), the Supplier shall perform a safety demonstration other than FMEA/FMECA being a single failure analysis.

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Displayed ID	Review Status	Object Type	Subsystem Safety Typical deliverables list								Requested Demonstration Type	Linked Evidence	Supplier Compliance Status	Supplier Compliance Statement	Alstom Review of Supplier Compliance	Alstom Review Statement	
			Ref	BRAKES	DOORS	HVAC	COUPLER	BATTERY									
5			Mandatory Safety Demonstrations (like FTA)	M	M	M when applicable [FN1]	M when applicable [FN1]	M when applicable [FN1]	M								
6 [136]			M: Mandatory HR: Highly Recommended R: Recommended Ref: Typical [FN1]: When a demonstration of a feared event or a functional failure rate specified relies on the combination of failures (complementary with single failure analysis like FMEA/FMECA), the Supplier shall perform a safety demonstration other than FMEA/FMECA by a single failure analysis.														
6 [137]			M: Mandatory HR: Highly Recommended R: Recommended list														
6 [177]			[FN2]: SIL Demonstrations for Safety Functions relying on Electronic or Programmable Electronic shall be performed: random failure target is						M	M							
6 [178]			Included and the required level of confidence on systematic failures (e.g. MRP, ESD, O&M process and hardware part design) shall be as per 4.2 R: Recommended P								PGR	CGR	FAI	Warrant			
			1 Safety Plan		P as per §4.2		F										
			2 Hazard Analysis		P as per §4.2		U	U				F					
			3 FMEA / FMECA									P		F			
			4 Safety Demonstration (like FTA)										P		F		
			5 SIL Demonstration											P		F	
			6 Safety Case (§4.3)											P		F	As built [FN]
			P = Preliminary U = Update (as necessary) F = Final /As-built														
			[FN]: The "as-built" is needed to reflect the safety related changes occurred during post FAI phase till end of warranty to have a safety case consistent with the as-built product. If no changes affecting the safety then Alstom just needs an updated document stating that the conclusions of the FAI safety case still applies to the as-built version of the product.														