

Abbreviations definition:		
Comment	abbreviation of:	Detailed meaning
C	Comply	Our proposal is compliant with this requirement
CWC	Comply With Comment	Our proposal is partly compliant to the requirement. Please refer to the following comment for our commitment detail.
N	Noted	We note this information. This information does not need any commitment from our side.
NA	Not Applicable	The requirement is not applicable to our scope of supply.
NC	Not compliant	Our proposal does not comply with this requirement
RFC	Request For Clarification	This requirement needs to be clarified/reviewed

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023																				
1	TECHNICAL SPECIFICATION																						
2	DTRF 150801 Generic Safety Specification for Supplied Sub-System																						
3	ENG-RSC-EN-RR-DTRF-0001 Rev. C Date: 03/2021																						
4	1 PURPOSE																						
5	The purpose of this document is to describe the management requirements and the generic requirements related to Railway Safety.	N																					
6	2 TERMS AND DEFINITIONS																						
7	<table border="1"> <thead> <tr> <th>Terms</th> <th>Definition</th> </tr> </thead> <tbody> <tr> <td>CGR</td> <td>Critical Gate Review</td> </tr> <tr> <td>FAI</td> <td>First Article Inspection</td> </tr> <tr> <td>FSD</td> <td>Fire & Smoke Detection</td> </tr> <tr> <td>MC</td> <td>Master Controller</td> </tr> <tr> <td>PGR</td> <td>Preliminary Gate Review</td> </tr> <tr> <td>SGR</td> <td>Specification Gate Review</td> </tr> <tr> <td>SIL</td> <td>Safety Integrated Level.</td> </tr> <tr> <td>SRAC</td> <td>Safety Related Application Conditions</td> </tr> <tr> <td>SSIL</td> <td>Software Safety Integrated Level.</td> </tr> </tbody> </table>	Terms	Definition	CGR	Critical Gate Review	FAI	First Article Inspection	FSD	Fire & Smoke Detection	MC	Master Controller	PGR	Preliminary Gate Review	SGR	Specification Gate Review	SIL	Safety Integrated Level.	SRAC	Safety Related Application Conditions	SSIL	Software Safety Integrated Level.	N	
Terms	Definition																						
CGR	Critical Gate Review																						
FAI	First Article Inspection																						
FSD	Fire & Smoke Detection																						
MC	Master Controller																						
PGR	Preliminary Gate Review																						
SGR	Specification Gate Review																						
SIL	Safety Integrated Level.																						
SRAC	Safety Related Application Conditions																						
SSIL	Software Safety Integrated Level.																						
8	3 APPLICABLE STANDARDS																						
9	References Observation																						
10	EN50126-1:2017 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) - Part1: Generic RAMS Process	C																					
11	EN50126-1:2017 Railway applications - The specification and demonstration of Reliability, Availability, Maintainability and Safety (RAMS) – Part2: Systems Approach to Safety	C																					
12	4 SAFETY MANAGEMENT																						
13	The Supplier agrees to: <input type="checkbox"/> Supply a safe product, <input type="checkbox"/> Comply with EN50126 part 1 and 2 and the regulations applicable to the project, <input type="checkbox"/> Justify that the product satisfies specified safety requirements, <input type="checkbox"/> Be fully responsible for the performances of his system. <input type="checkbox"/> Inform Alstom about Safety Related Application Conditions (SRAC) and assumptions for which it is not responsible (related to storage, operation, inspection, etc.).	C																					

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023
14	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.	C	
15	4.1 LIST OF TYPICAL DOCUMENT AND SAFETY ANALYSES		
16	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.	C	
17	Complementarily any specific requirements will be addressed in TPS.	C	
18	4.1.1 SAFETY PLAN		
19	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.	C	
20	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.	C	
21	If a Safety plan is produced, it will be sent for acceptance before the contract award.	CWC	The Safety Plan is in Voith Standard.
22	This document can be combined with a RAM Plan.	C	
23	4.1.2 HAZARD ANALYSIS		
24	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.	CWC	The Hazard Analysis is in Voith Standard.
25	4.1.3 FMEA / FMECA		
26	The Failure Modes and Effects Analysis (FMEA) is a systematic, formal procedure for analysing a subsystem to	C	
27	The FMECA (Failure Modes, Effects and Criticality Analysis) is an extension of the FMEA that includes a	C	
28	A summary of all mitigation measures impacting hazards resulting from the FMECA analysis is communicated to Alstom.	CWC	No separate Summary Reports will be delivered. All relevant hazards can be filtered in the FMECA sheet.
29	Standard EN 60812 can be used as a reference.	C	
30	This document can be combined to include both safety and reliability point of views.	C	
31	4.1.4 FAULT TREE (SAFETY)		
32	The aim of the fault tree is to demonstrate the proposed design achieves the specified safety requirements (quantitatively and qualitatively).	C	
33	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.	C	
34	Assumptions and calculations rules shall be communicated with the supplied fault tree.	C	
35	Standard EN 61025 can be used as a reference.	C	
36	Other tools can be used (like Markov or petri net).	C	
37	4.1.5 SAFETY MANAGEMENT FILE		
38	The hazards identified, decisions made, solutions adopted and their implementation status are recorded in a management file or Hazard Log.	C	
39	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	C	

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023
40	All mitigation measures (or SRAC) under Alstom responsibility shall be extracted from this file (usually called hazard record).	C	
41	4.2 ACTIVITIES BEFORE THE CONTRACT SIGNATURE		
42	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.	C	
43	The Supplier shall send the list of hazardous events considered for the design of his equipment / subsystem	C	
44	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: <input type="checkbox"/> Application of recognised standards, <input type="checkbox"/> Carry out tests (send the validation plan), <input type="checkbox"/> Use subsystems / components certified by a reputable organisation, <input type="checkbox"/> Use subsystems / components proven in practice, <input type="checkbox"/> Respect qualitative requirements during the design (Redundancy – Fail Safe criterion, etc.), <input type="checkbox"/> Respect quantitative requirements during the design (for example frequency at which a feared event occurs) <input type="checkbox"/> 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).	C	
45	The supplier shall send the mitigations and main assumptions under Alstom responsibility if any.	C	
46	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).	C	
47	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).	C	
48	4.3 ACTIVITIES DURING DEVELOPMENT PHASE		
49	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.	C	
50	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:	CWC	No Safety Case will be provided, only Coupler Technical Report as described in the next rows
51	<input type="checkbox"/> 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: o Storage, o Integration, o Commissioning, o Operation, o Tests and inspections to be made, o Maintenance o Restrictions of use. The mitigation measures refer to exported safety requirements coming from safety analysis if any. The	CWC	

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023
52	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. When no SRAC are communicated, a statement shall be written to prevent any misunderstanding.		No Safety Case will be provided, only Coupler Technical Report. The Safety Technical Report with its format as used and already mutually agreed within the recent projects (Pune Metro L3, DSB NT, Romania) will be provided for any further projects with project specific modifications.
53	<input type="checkbox"/> Documents describing that all defined prevention measures have been correctly implemented: <ul style="list-style-type: none"> o Evidence of conformity with recognised standards, o Certificates for subsystems / components, o Justification file based on operating experience o Evidence of conformity with defined qualitative requirements, 	CWC	
54	<ul style="list-style-type: none"> o Evidence that quantitative requirements are respected and therefore that: <ul style="list-style-type: none"> <input type="checkbox"/> 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). <input type="checkbox"/> The source of failure rates used is defined (operating experience, expert opinion, database). <input type="checkbox"/> Common cause failures (hardware and software) are evaluated. <input type="checkbox"/> Justification of compliance of the development to any Safety function relying on software shall be provided (typically compliance to EN50128). <input type="checkbox"/> Assumptions used for the study are listed. <input type="checkbox"/> 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. <input type="checkbox"/> The list of identified dangerous failure modes, <input type="checkbox"/> etc. 	CWC	
55	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.	CWC	
56	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.	CWC	
57	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).	CWC	
58	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..	CWC	
59	4.4 ACTIVITIES DURING THE OPERATION PHASE		
60	The Supplier agrees that throughout the life of the component it shall: <ul style="list-style-type: none"> <input type="checkbox"/> Analyse any failures critical for safety <input type="checkbox"/> If necessary, recall and modify components / subsystems in operation <input type="checkbox"/> Update predictive studies carried out and send the updated safety file to Alstom (as necessary). 	CWC	Modification in case of technical feasibility and economical reasonability.
61			
62	5 TYPICAL SAFETY REQUIREMENTS		
63			
64	The Safety requirements are formalised and agreed prior contract award. On case by case basis (e.g. when a	C	
65	Safety demonstrations provided by supplier will be reviewed and action closed when accepted by Alstom. The	C	
66	Interface with others equipment and associated safety requirements will be defined further and before contract	C	

Item N°	Customer specification		Voith answer	Voith & Alstom Comment 15 May 2023
67	The specific functional safety requirements and targets are defined in the relevant TPS.		C	
68	5.1 HVAC			
69	FSR	Functional Safety Requirements	Target	
70	FSR01	Hazard: Asphyxia due to fire on board Feared Event: Fire start or a smoke release from the HVAC *Return of Experience stating the occurrence is improbable is recommended.	< 1 E-8 / h *	NA
71	FSR02	Hazard: Projectile/pressure wave Feared Event: HVAC explosion *Return of Experience stating the occurrence is improbable is recommended.	< 1 E-8 / h *	NA
72	FSR03	Hazard: Electrocution Note: It shall cover all operations phases. Feared Event: HVAC failures leading to electrocution (Voltage >=400 V) *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.	< 1 E-9 / h *	NA
73	FSR04	Hazard: Intoxication / Pollution Feared Event: Failures leading to refrigerant leak outside the HVAC unit (apply when refrigerant is toxic) *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is improbable is recommended.	< 1 E-7 / h *	NA
74	FSR05	Hazard: Collision/projectile Feared Event: Failures leading to gauge fouling or fall/projection of HVAC parts *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.	< 1 E-9 / h *	NA
75	5.2 PANTOGRAPH			
76	FSR	Functional Safety Requirements	Target	
77	FSR01	Hazard: not able to cut-off or isolate HV supply Feared Event: Not able to lower the pantograph given order is sent	< 1E-7/h	NA
78	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)	< 1E-7/h	NA

Item N°	Customer specification			Voith answer	Voith & Alstom Comment 15 May 2023
79	FSR03	Hazard: Collision/projectile Feared Event: Failures leading to gauge fouling or fall/projection of Pantograph parts *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.	< 1E-9/h *	NA	
80	FSR04	Calculation note to demonstrate fixations are adequate and redundant..	N/A	NA	
81	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)	N/A	NA	
82	5.3 DOORS				
83	FSR	Functional Safety Requirements	Target		
84	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)	Supplier contribution tbd in TPS	NA	
85	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)	Supplier contribution tbd in TPS	NA	
86	FSR03	Hazard: People falling of train in operation Feared event: Loss of door closing effort allowing opening *Qualitative demonstration accepted.	< 1E-9/h*	NA	
87	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)	Supplier contribution tbd in TPS	NA	
88	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)	Supplier contribution tbd in TPS	NA	
89	FSR06	Hazard: Departure of the train with something* or someone gripped by doors Functional Requirement: To not start with a passenger trapped during closing/opening phase (up to SIL4 at Train level) *: minimum size of the object specified in TPS	Supplier contribution tbd in TPS	NA	
90	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)	Supplier contribution tbd in TPS	NA	
91	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)	N/A	NA	
92	FSR09	Hazard: Departure of the train with something or someone gripped by doors Qualitative requirement : Compliance to EN14752	N/A	NA	

Item N°	Customer specification			Voith answer	Voith & Alstom Comment 15 May 2023
93	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)	Supplier contribution tbd in TPS	NA	
94	5.4 BATTERY				
95	FSR	Functional Safety Requirements	Target at train level		
96	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) *Return of Experience and recognized standard compliance (eg EN60529) stating the occurrence is improbable is recommended.	< 1E-9/h *	NA	
97	FSR02	Hazard: Asphyxia due to fire on board Feared event: Fire start or smoke release from Battery	< 1E-8/h	NA	
98	FSR03	Hazard: Electrocutation Feared Event: Battery failure leading to electrocution Note: It shall cover all operations phases	< 1E-9/h	NA	
99	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.	< 1E-9/h	NA	
100	FSR05	Hazard: Collision/projectile Feared event: Failures leading to gauge fouling or fall/projection of Battery parts *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended.	< 1E-9/h *	NA	
101	5.5 COUPLER				
102	Generic Functional Safety Requirements for automatic or semi-permanent couplers:				
103	FSR	Functional Safety Requirements	Target at train level		
104	FSR01as	Hazard: Collision/projectile Feared event: failures leading to gauge fouling or fall/projection of coupler parts * Qualitative demonstration relying on recognized standard compliance and stating the occurrence is incredible is recommended	< 1E-9/h*	C	
105	FSR02as	Calculation note to demonstrate fixations on carbody are adequate and redundant (when applicable)	No quantitative target	C	

Item N°	Customer specification			Voith answer	Voith & Alstom Comment 15 May 2023
106	FSR03as	Mechanical tests compliant with the TPS requirements	No quantitative target	CWC	Regards the mechanical tests related to Railway Safety. In case of non-compliance identified on some tests, Voith may substantiate the result doesn't jeopardize safety.
107	Generic Functional Safety Requirements for automatic couplers:				
108	FSR	Functional Safety Requirements	Target at train level		
109	FSR01a	Hazard: Derailment/Collision Feared event: Undue automatic coupler uncoupling *Qualitative demonstration stating the occurrence is incredible is accepted.	< 1E-8/h*	C	
110	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) *Qualitative demonstration stating the occurrence is incredible is accepted.	< 1E-9/h*	CWC	Applicable to brake pipe. Regarding the main reservoir pipe, depends of Voith scope of supply. In case a valve is provided, the best performance reachable is 1E-7/h.
111	FSR03a	Hazard: Collision Feared Event: Untimely uncoupling with a complete or partial closure of the Brake Pipe (when applicable) *Qualitative demonstration stating the occurrence is improbable is accepted.	< 1E-7/h*	C	
112	FSR04a	Hazard: loss of safety function relaying on train line Feared Event : Untimely grounding of a low voltage train line (in coupled or uncoupled status) (When applicable) *Qualitative demonstration stating the occurrence is improbable is accepted.	< 1E-7/h*	RFC	Design according to UIC 533 therefore no quantitative target.
113	FSR05a	Hazard: loss of safety function relaying on train line Feared Event : Untimely feeding of a low voltage train line with an energized low voltage line (in coupled or uncoupled status) (When applicable) *Qualitative demonstration stating the occurrence is incredible is accepted.	< 1E-9/h*	RFC	Design according to UIC 533 therefore no quantitative target.
114	FSR06a	Coupler compliant with EN60352 and IEC 61373 (to confirm robustness of electrical connections in line with FSR04 & FSR05) Note: Discrepancy with IEC 61373 test requirements will be managed through the TPS if any will be added.	No quantitative target	RFC	We comply to EN60352 & IEC 61373.
115	Generic Functional Safety Requirements for semi-permanent couplers:				
116	FSR	Functional Safety Requirements	Target at train level		
117	FSR01s	Hazard: Derailment/Collision Feared event: Undue permanent or semi- permanent uncoupling *Qualitative demonstration stating the occurrence is incredible is accepted.	< 1E-9/h*	C	
118	5.6 BRAKES				
119	The defined failure modes consider the "full-scope" of brake system including brake control, air supply and bogie			NA	

Item N°	Customer specification			Voith answer	Voith & Alstom Comment 15 May 2023
120	FSR	Functional Safety Requirements	Target at train level		
121	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)	< 1E-9/h*	NA	
122	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)	<1E-6/h	NA	
123	FSR03	Hazard: Derailment/fire Feared event: Undue undetected Brake (all types of brake) application while running (up to 1E-9/h at Train level)	Supplier contribution tbd in TPS (in particular allocation between undue application vs detection)	NA	
124	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.	<1E-09/h (note 2)	NA	
125	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)	To be defined on a case by case basis according to the THR apportionment from train level	NA	
126	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	<1E-6/h	NA	
127	FSR07	Hazard: Passenger injuries Excessive jerk (as specified in the TPS)	To be demonstrated by validation test	NA	
128	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.	<1E-9/h*	NA	
129	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)	Supplier contribution tbd in TPS	NA	

Item N°	Customer specification			Voith answer	Voith & Alstom Comment 15 May 2023
130	FSR10	Hazard: People falling of train Functional requirement: To provide the standstill/zero velocity information (up to 1E-7/h/SIL2)	Supplier contribution tbd in TPS	NA	
131	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)	Supplier contribution tbd in TPS	NA	
132	5.7 FIRE & SMOKE DETECTION (AND EXTINGUISHING) SYSTEM (FSD)				
133	FSR01	Hazard: Asphyxia due to fire on board Functional Requirement: To detect fire in hazardous locations(1) and communicate the information through a LV output de-energized (up to SIL2(2)). (1): Typically, MV/HV cubicles (like traction box, Main Transformer) or power pack. Items to be protected are specified in TPS. (2): when required, software developed in accordance with SIL2 requirements of EN50128 or EN50657 and hardware in accordance with SIL2 requirement of EN50129 or equivalent. Compliance to EN50121 also required.	<1E-9/h*	NA	
134	FSR02	Hazard: Asphyxia due to fire on board Functional Requirement: To release firefighting agent in defined location(s) when an order(1) is received (up to SIL2). (1): type of order is specified in TPS (like LV input energized)	Supplier contribution tbd in TPS	NA	
135	FSR02a(1)	Hazard: Cancerogenic or toxic firefighting agent Feared event: Untimely release(2) of firefighting agent when presence of person is foreseen (like during maintenance). (1): Applicable when the safety requirement FSR02 applies and the firefighting agent is toxic (water mist being recommended). (2): Release shall be prevented when the train is not in commercial service and appropriate ventilation requirement defined to ensure the access is safe after a release. (3): Qualitative demonstration accepted.	≤ 1E-9/h(3)	NA	
136	FSR03	Hazard: various Qualitative requirement: Compliance with IEC61373, EN50155, environmental conditions defined for the project (e.g. tests in accordance with EN60068 performed) and EN45545(1) (1): EN45545 requirements are specified in TPS if any	N/A	NA	
137	5.8 Master Controller				

Item N°	Customer specification		Voith answer	Voith & Alstom Comment 15 May 2023	
138	FSR01	<p>Feared Events to be demonstrated for the complete system (driver's device, control lever, transfer mechanism and switch):</p> <ul style="list-style-type: none"> - Contact(1) NO blocked closed when it is released by the driver - Contact(1) NO blocked opened when it is activated by the driver - Contact(1) NC blocked open when it is released by the driver - Contact(1) NC blocked closed when it is activated by the driver <p>Remarks :</p> <ul style="list-style-type: none"> - evaluation per contact, whatever the function performed - Interlocking between contacts if any shall be documented - Interlocking between sub-systems(2) if any shall be documented 	< 1 E-7 / h	NA	
139	FSR02	<p>Hazard: When removing the key to let a switch in an unwanted position</p> <p>Feared Event: In the absence of cab Key, a contact(1) not in expected position</p> <p>* Qualitative demonstration stating that the occurrence is improbable can be also accepted</p>	< 1 E-7 / h*	NA	
140	FSR03	<p>Hazard: Deadman not detected</p> <p>Functional Requirement: To release the Deadman acknowledgement Input: no more Driver acknowledgement</p> <p>Treatment: when Deadman acknowledgement is released*, the output from E/PE** is set at 0 (de-energized)</p> <p>* All the conditions used to acknowledge the Deadman shall be considered.</p> <p>** Electronic/Programmable Electronic</p> <p>*** software developed in accordance with SIL2 requirements of EN50128 or EN50657 and hardware in accordance with SIL2 requirement of EN50129 or equivalent. Compliance to EN50121 also required.</p>	SIL2*** <2E-7/h	NA	
141	FSR04	<p>Hazard: Unwanted traction/brake order or effort requested greater than the one expected</p> <p>Functional Requirement: To communicate the traction/brake effort based on the position of the Traction/Brake Handle.</p> <p>Input: Position of the Traction/Brake Handle</p> <p>Treatment: Given the position of the Traction/Brake Handle, the output from E/PE* is set as expected (Considering the redundancy if any).</p> <p>* Electronic/Programmable Electronic</p> <p>** software developed in accordance with Basic Integrity requirements of EN50128 or EN50657.</p>	Basic Integrity** <2E-5/h	NA	
142	FSR05	<p>Master Controller compliant with IEC61373, EN50155 and environmental conditions defined for the project (e.g. tests in accordance with EN60068 performed).</p>	N/A	NA	
143	FSR06	<p>Hazard: Emergency Brake order released</p> <p>Qualitative requirement: The emergency braking position is notched and stable.</p>	N/A	NA	

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023
144	(1) Applies for all contacts of Master Controller including Speed Direction, Key Switch, Mode Selector and Running Direction, if any. (2) Traction/Brake Handle, Speed Direction, Key Switch, Mode Selector and Running Direction	NA	
145	5.9 TOILET		
146	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:		
147	FSR01 Hazard: Asphyxia due to fire on board Feared Event: smoke release from the Toilet not detected(1) * Qualitative demonstration stating the occurrence is improbable is recommended. (1) On project basis detection relying on smoke detector installed and part of supplier scope of supply	≤ 1 E-8 / h *	NA
148	FSR02 Hazard: Electrocutation Note: It shall cover all operations phases (like maintenance). Feared Event: Contact with part under voltage leading to electrocutation *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is improbable is recommended.	< 1 E-7 / h *	NA
149	FSR03 Hazard: Fall of parts Feared Event: Failures leading to fall of Toilet parts * Qualitative demonstration relying on safety cable stating the occurrence is improbable is recommended.	< 1 E-7 / h *	NA
150	FSR04 Hazard: no emergency escape (considering also person with reduced mobility and door locked from outside) Feared Event: Door failure leading to jeopardize emergency evacuation *Qualitative demonstration relying on recognized standard compliance and stating the occurrence is improbable is recommended.	≤ 1 E-7 / h*	NA
151	FSR05 Hazard: Presence of sharp objects or pinch points Feared Event: Passenger contact with a sharp object or pinch point* (e.g. when door closing) * Pinch points as defined in EN12221-2 §5.3.1 to §5.3.3 or those specified in TPS apply	N/A	NA
152	FSR06 Hazard: Information not transmitted to the driver/ train crew Feared Event: Passenger unable to call for help * Qualitative demonstration stating the occurrence is improbable is accepted. (1): Applicable when required by regulation (TSI PRM).	≤ 1 E-7 / h *	NA
153	FSR07 Hazard: various Qualitative requirement: Compliance with IEC61373, EN50155, EN50153, environmental conditions defined for the project (e.g. tests in accordance with EN60068 performed) and EN45545(1) (1): EN45545 requirements are specified in TPS if any	N/A	NA

Item N°	Customer specification		Voith answer	Voith & Alstom Comment 15 May 2023																																																																																								
154	FSR08	<p>Hazard: Drinking water contamination (1) (2) (3) Feared Event: Drinking water contamination due to improper design or any kind of failure * Qualitative demonstration relying on recognized standards compliance (like EN1717), qualified material used and manufacturing/storage prevent contamination and stating the occurrence is incredible is expected (1) : Applies when drinkable water is specified. If not, the hazard shall be mitigated by appropriate safety warning. (2) : Contamination from a passenger is excluded (3): Exported constraints (SRAC) defined and shared (like cleaning requirement, maintenance constraints)</p>	N/A*	NA																																																																																								
155	5.10 OTHER COMMODITIES																																																																																											
156	For other commodities not specifically detailed in the current revision of the present document (eg. Fire & Smoke Detection, Master Controller....etc.) the functional safety requirements will be defined in the relevant TPS.		NA																																																																																									
157	6 SAFETY DELIVERABLES																																																																																											
158	The below list of safety deliverables is the by default list to be applied for each commodity. It can be adjusted		C																																																																																									
159	<table border="1"> <thead> <tr> <th>Ref</th> <th>Subsystem Safety Typical deliverables list</th> <th>BRKES</th> <th>DOORS</th> <th>HVAC</th> <th>COUPLER</th> <th>BATTERY</th> <th>PANTO</th> <th>MC</th> <th>FSD</th> <th>TOILET</th> </tr> </thead> <tbody> <tr> <td>1</td> <td>Safety Plan</td> <td>M</td> <td>M</td> <td>R</td> <td>-</td> <td>-</td> <td>R</td> <td>-</td> <td>R</td> <td>-</td> </tr> <tr> <td>2</td> <td>Hazard Analysis⁽⁴⁾</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>-</td> <td>M when applicable ⁽⁴⁾</td> <td>M</td> </tr> <tr> <td>3</td> <td>Safety Management file (Hazard Log) ⁽⁴⁾</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> <td>-</td> </tr> <tr> <td>4</td> <td>FMEA/FMECA</td> <td>M</td> <td>M</td> <td>HR</td> <td>R</td> <td>R</td> <td>HR</td> <td>M</td> <td>M</td> <td>HR</td> </tr> <tr> <td>5</td> <td>Safety Demonstrations (like FTA)</td> <td>M</td> <td>M</td> <td>M when applicable ⁽¹⁾</td> <td>M when applicable ⁽¹⁾</td> <td>M when applicable ⁽¹⁾</td> <td>M when applicable ⁽¹⁾</td> <td>M</td> <td>M when applicable ⁽¹⁾</td> <td>M</td> </tr> <tr> <td>6</td> <td>SIL Demonstration</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> <td>-</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> <td>M when applicable ⁽²⁾</td> </tr> <tr> <td>7</td> <td>Safety Case (§4.3)</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> <td>M</td> </tr> </tbody> </table>	Ref	Subsystem Safety Typical deliverables list	BRKES	DOORS	HVAC	COUPLER	BATTERY	PANTO	MC	FSD	TOILET	1	Safety Plan	M	M	R	-	-	R	-	R	-	2	Hazard Analysis ⁽⁴⁾	M	M	M	M	M	M	-	M when applicable ⁽⁴⁾	M	3	Safety Management file (Hazard Log) ⁽⁴⁾	-	-	-	-	-	-	-	-	-	4	FMEA/FMECA	M	M	HR	R	R	HR	M	M	HR	5	Safety Demonstrations (like FTA)	M	M	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M	M when applicable ⁽¹⁾	M	6	SIL Demonstration	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	-	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	7	Safety Case (§4.3)	M	M	M	M	M	M	M	M	M		C	
Ref	Subsystem Safety Typical deliverables list	BRKES	DOORS	HVAC	COUPLER	BATTERY	PANTO	MC	FSD	TOILET																																																																																		
1	Safety Plan	M	M	R	-	-	R	-	R	-																																																																																		
2	Hazard Analysis ⁽⁴⁾	M	M	M	M	M	M	-	M when applicable ⁽⁴⁾	M																																																																																		
3	Safety Management file (Hazard Log) ⁽⁴⁾	-	-	-	-	-	-	-	-	-																																																																																		
4	FMEA/FMECA	M	M	HR	R	R	HR	M	M	HR																																																																																		
5	Safety Demonstrations (like FTA)	M	M	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M when applicable ⁽¹⁾	M	M when applicable ⁽¹⁾	M																																																																																		
6	SIL Demonstration	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	-	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾	M when applicable ⁽²⁾																																																																																		
7	Safety Case (§4.3)	M	M	M	M	M	M	M	M	M																																																																																		
160	M : Mandatory HR : Highly Recommended R : Recommended		C																																																																																									
161	(1) : 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 being a single failure analysis.		C																																																																																									
162	(2) : SIL Demonstration for Safety Functions relying on Electronic or Programmable Electronic shall be performed: random failure target is achieved and the required level of confidence on systematic failures (e.g. software development process and hardware part design) shall be justified.		C																																																																																									
163	(3) : Applies when the gas used for extinguishment is toxic		C																																																																																									

Item N°	Customer specification	Voith answer	Voith & Alstom Comment 15 May 2023																																																																
164	(4) : 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).	CWC	See chapter 4.3 for details																																																																
165	(5) : 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).	CWC	See chapter 4.3 for details																																																																
166	<table border="1"> <thead> <tr> <th>Ref</th> <th>Safety Deliverables</th> <th>Consultation</th> <th>SGR</th> <th>PGR</th> <th>CGR</th> <th>FAI</th> <th>Warranty</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Technical information as per §4.2</td> <td>P</td> <td></td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>1</td> <td>Safety Plan</td> <td>P as per §4.2</td> <td>F</td> <td></td> <td></td> <td></td> <td></td> </tr> <tr> <td>2</td> <td>Hazard Analysis</td> <td>P as per §4.2</td> <td>U</td> <td>U</td> <td>F</td> <td></td> <td></td> </tr> <tr> <td>3</td> <td>FMEA / FMECA</td> <td></td> <td></td> <td></td> <td>P</td> <td>F</td> <td></td> </tr> <tr> <td>4</td> <td>Safety Demonstration (like FTA)</td> <td></td> <td></td> <td></td> <td>P</td> <td>F</td> <td></td> </tr> <tr> <td>5</td> <td>SIL Demonstration</td> <td></td> <td></td> <td></td> <td>P</td> <td>F</td> <td></td> </tr> <tr> <td>6</td> <td>Safety Case (§4.3)</td> <td></td> <td></td> <td></td> <td>P</td> <td>F</td> <td>As built*</td> </tr> </tbody> </table>	Ref	Safety Deliverables	Consultation	SGR	PGR	CGR	FAI	Warranty	0	Technical information as per §4.2	P						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*	CWC	See chapter 4.3 for details
	Ref	Safety Deliverables	Consultation	SGR	PGR	CGR	FAI	Warranty																																																											
	0	Technical information as per §4.2	P																																																																
	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*																																																												
167	*:The "as-built" is needed to reflect the safety related changes occurred during post FAI phase till end of warranty to have a safety report 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 report still applies to the as-built version of the product.	C																																																																	