HF-working stream: Proposed detailed HF-related requirements

The safety requirements and provisions described below aim to ensure a safe interaction between the user and the ADS. This is achieved by increasing the usability of the technology, simplicity in the perception of the user and an appropriate mental model of the ADS. The need for an appropriate mental model has been stated by, for example, Halasz and Moran (1983): ".... the psychological function of a mental model of a system is to provide an effective problem space [...] in which the user can reason about the operations available on the system." All the requirements below have been derived to achieve these safety-related considerations.

As is now indicated in the overall safety topic with user we mean at the moment: 'authorised user in the vehicle'. With this we hope to indicate that the PTs 9-15 relate to L3/L4 driving where a user is involved that may need to take over. This also means that L5 still needs to be addressed. As well as remote driving and L4 robo-taxis.

Halasz, F. G., & Moran, T. P. (1983). Mental models and problem solving in using a calculator. In Proceedings of CH1'83 Human Factors in Computing Systems. New York: ACM

General comment: distinguish between within ADS and across ADS
Where do we address users with specific needs?
shall may become should depending on FRAV discusison/decision

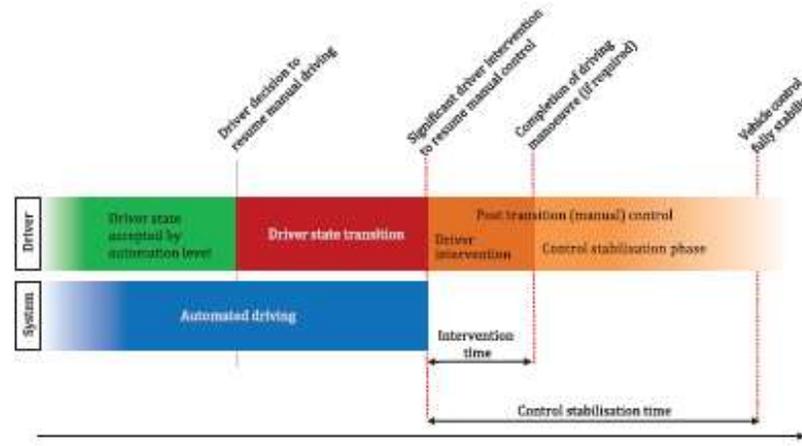|	Safety Requirement	Provisions	Comments
The ADS shall interact safely with the authorized user in the vehicle			

9	User interaction with and the interface of ADS (features) shall have a high-level commonality of design	1) The ADS should be designed to foster a level of trust that is aligned with its capabilities and limitations to ensure proper use of the system[1]
		 2) The operation of the interaction shall have in common:
		   a) [use of common sequence of states in the transition/activation/overriding/…]
			1) may be difficult to assess and need to be addressed.
			 Possibilities for 2:
			   a) [buttons]

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[1] Calibrated Trust: A state where the automation user's trust in the automation, as well as their use of the automation, is appropriately adjusted to the actual performance of the automation (McGuirl & Sarter, 2006). See P. 89 Human Factors Design Guidance for Level 2 and Level 3 Automated Driving Concepts (nhtsa.gov)

		3) The interaction should be simplified:
		  a) [Limit the number of roles]
		  b) [Limit the number of potential transitions]
		  c) [Limit the number of settings]
		  d) [Limit the number of different interaction modes]
			b) [signalling]
			c) [interior lighting]
			d) [steering wheel retraction]
			e) [....]
			
			Definition of commonality

10	The ADS HMI shall provide clear and unambiguous information on current and upcoming conditions to the user	1) The vehicle shall indicate its ADS capabilities in terms of their automated features and their ODD.
		
		2) The ADS shall inform the user on the current conditions:
		  a) ADS status information
		  b) ==The availability of automated features==
		  c) User Role
		  d) Responsibility
		  e) Permitted NDRA
		  f) Potential roles to activate
		  g) =="Standard" information==
		    i) ==Vehicle speed, range and Time to Fuel==
		  h) ADS failure information
		
		3) The ADS shall inform the user on the upcoming conditions:
		  a) ODD boundaries
		  b) Upcoming actions or change in roles
		  c) Oncoming decisions/manoeuvers
		  d) Estimated time until take over in normal conditions
		  e) Transition related communication.
		
		4) The ADS shall ensure that safety related information is prioritised and presented in a clear and unambiguous manner.
			Open issues:
			
			Which information needs to be presented continuously?
			
			Which information needs to be presented where?
			
			What kind of information falls under 1a) ADS status information?
			
			What kind of information falls under 1h) Availability of automated features
			
			OICA/CLEPA indicated that 2g can be removed
			
			==Does 2b covers what Japan was proposing?==

11	The ADS shall be designed to prevent misuse and errors in operation	1) The ADS shall be designed to prevent inadvertent activation or deactivation 2) The controls dedicated to the ADS shall be clearly distinguishable from other controls	

		3) The ADS shall provide feedback when the user attempts to enable unavailable functions	
12	The ADS shall be designed to assure a safe ADS feature activation	1) The ADS shall inform the user that preconditions for activation are met 2) The activation should follow a common sequence of actions and states a) Common sequence to be a pass/fail criterion 3) The ADS shall provide confirmation that the system is activated	

13	The ADS shall be designed to assure a safe Transition Of Control	1) The interaction shall follow a common sequence of actions and states in the transition of control (change of user roles)
		   a) Common sequence to be a pass/fail criterion
		
		Figure 2 — System-initiated transition from automated to manual driving [2]
		
		2) Transition of control shall return to a common default user role (to prevent mode confusion and other risks)
		   a) This shall normally be fully engaged driving (conventional driver)
		   b) Common default user to be a pass/fail criterion
		3) The ADS shall continuously verify whether the user is available for the transition of control and warn the user if not available when required
		4) The ADS shall verify that the driver is in stable control of the vehicle to complete the Transfer of Control to the user
		5) During transition, the ADS shall remain active until the transfer of control has been completed or the ADS reaches a minimal risk condition
			Check with different ADS

14	The ADS shall be designed to assure a safe user initiated take over	1) The user is allowed to initiate a take-over process of the ADS	USA: 4 should only apply in special circumstances.

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[2] Reference: ISO/TR 21959-1:2020(E)

		2) The ADS should monitor the driver's fatigue condition and issue a takeover request early enough where a takeover is not impaired by the driver's condition. (Canada) 3) The deactivation ~~should~~ shall follow a common sequence of actions and states in the transition of control (change of user roles) a) Common sequence to be a pass/fail criterion (ISO/TR 21959-1:2020(E)) 4) The ADS may delay deactivation of driving control when immediate human resumption of control could compromise safety. 5) The ADS ~~should~~ shall provide a clear feedback of the successful user initiated take over using acoustic and visual signals (Canada) a) The clear feedback to be a pass/fail criterion 6) The user initiated take over shall return to a common default user role being the driver a) This shall normally be a fully engaged driver without any control assistance (conventional driver) b) Common default user role to be a pass/fail criterion	Reply: True. A strategy needs to be considered based on different cases. If a first attempt prevention is enough or the ADS has a better overview of complex traffic situations and prevents the takeover. Or other solutions. safe and unsafe conditions examples: traffic density, distance to other vehicles, clear view, not-mid-manoeuvres, ... UK: concern about there ever being a case where the user cannot retake control of the vehicle. There will be situations where the ADS fails to properly perceive the situation. If a system starts to perform a manoeuvre because it thinks that is the correct course of action, but the user can clearly see it is wrong and has the ability to intervene, then they should be able to. Additionally it seems likely that the public would be more willing to initially take up ADS if they know they can always take back control, particularly when many of the technologies are new. Situations where it would actually be unsafe for the

			human to take control would be very rare. Would a warning indicating the danger to the user be sufficient? 3 is taken from ISO 4 is based on ECE/TRANS/WP.29/1140 6a is based on results on EU co-funded project Have-It
~~15~~	~~The ADS manufacturer OEM should shall provide tools for the authorized user to learn about system functionality and operation.~~	~~Process requirements:~~ ~~1) ADS manufacturer OEM should describe the possible educational approach:~~ ~~a) Theoretical and practical training~~ ~~b) How it aligns with common HMI and interaction~~ ~~2) ADS manufacturer OEM should provide documented information on ADS (features) capabilities and limitations (the information should also refer to specific scenarios)~~ ~~ADS type requirements:~~ ~~3) ADS manufacturer OEM should provide documented information on roles and responsibility of driver/user and ADS when ADS (feature) is on/off~~ ~~4) ADS manufacturer OEM should provide documented information on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override)~~ ~~5) ADS manufacturer OEM should provide a general overview list of NDRA allowed when an ADS feature is active~~ ~~6) The ADS supports the user in correct operation (coaching)~~ ~~7) The ADS gives prompt feedback on erroneous operation~~	
15	The use of the ADS shall be supported by documentation and tools to facilitate the authorized user in	**Documentation:** The following information should be documented: 1. description of the possible educational approach: a. Theoretical and practical training	Question: How should allowed NDRA be indicated.

	understanding the functionality and operation of the system	b. How it aligns with common HMI and interaction 2. Operational Description of ADS (features) capabilities and limitations (the information should also refer to specific scenarios) 3. Description on roles and responsibility of driver/user and ADS when ADS (feature) is on/off 4. description on allowed transition of roles and procedure for the transition (activation/deactivation, ToC, Override) 5. general overview ~~list~~ of NDRA allowed when an ADS feature is active **Tools:** 6. The ADS supports the user in correct operation (coaching) 7. The ADS gives prompt feedback on erroneous operation	Reply: No idea yet but will be relevant at a more detailed level OICA/CLEPA: This PT should be addressed somewhere else 1 – 5: *Support the general mental model (common understanding)* 6 – 7: *Support the applied mental model (understanding the ADS-specifics)*

16	Passenger-carrying ADS vehicles that may operate without a fallback user (or fallback-ready user) shall provide means for ensuring passenger safety. ~~, information and~~ communication with ~~[a remote operator/user-in-charge/human driver/remote assistance personnel]~~ a remote operation dispatcher/assistance personnel	1. For the safety of the occupants, the ADS vehicle should:
		   a) Provide stops in the places according to the designated route;
		   b) Provide opening the service doors at the vehicle stop and closing them before starting the motion after the stop;
		   c) Provide means for the emergency stop of a vehicle by the occupants («emergency brake»);
		   d) Provide sound notification of the occupants in the case of emergency braking.
		2. For the occupant information, the ADS vehicle should provide audio messages to the occupants about approaching a stop and starting the motion after a stop.
		3. The ADS vehicle should provide voice communication between the occupant compartment and a remote operation dispatcher/assistance personnel.
			Proposed by Russia. To be discussed 7 December 2021
			
			define passenger
			
			can the provisions be addressed under other safety requirements.

new l	Human Factors process requirements for safe and usable ADS HMI/ safety management systems (SMS) approach	1) Analyses of user needs and risk, setting safety and usability objectives, as well as specifying user requirements and ensuring user understanding and context 2) Producing design solutions to meet these requirements 3) Conducting evaluations, particularly real world testing on real users (i.e., not the engineers developing the products)	Proposed by Canada. Discussed 26 October. Check with SG3 VMAD Updated by Canada (purple text) no update 7 December

		4) Human factors design and testing activities should be assigned to qualified personnel, with clearly defined roles and responsibilities, including process oversight and sign-off. 5) Device performance should be monitored in the field and this information should be used to set future design targets and evaluate[3] designs against these requirements.	
new II	Accessibility and usability	The ADS should be able to appropriately interact with users with disabilities both on-board and approaching/leaving the ADS vehicle	Proposed by EC. Discussed 26 October. Check where and how to address. Currently suggested to be addressed in a new safety requirement (see below).
new III	The integration of the ADS with the entire vehicle HMI shall be assured	1) The entire HMI design should be described and the integration with ADS HMI assured (by analysis and/or test) 2) Multifunctional switch-gear should be avoided as much as possible 3) The vehicle and ADS HMI needs to take into account potential impairments of authorised users (such as colour blindness, impaired hearing) which do not require specific hardware adaptations of the vehicle.	Proposed by NL and ETSC

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[3] Evaluation should include an analysis of the user's correct interpretation of the actual driving mode and its affiliated responsibilities and (driving) tasks:

- In the moment of a mode transition.
- While driving with the same automation mode for a certain period of time