Pre-commercial Procurement (PCP) FABULOS

Future Autonomous Bus Urban Level Operation Systems

TENDER DOCUMENT 2":

FUNCTIONAL SPECIFICATIONS *(version for Phase 3 call-off)*

Deadline for receipt of the offers:

Monday 6 January 2020 at 23:59 PM CET

These Functional Specifications, designated as Tender Document 2", should be read in conjunction with other documents related to this Pre-Commercial Procurement (PCP), listed hereunder:

- Tender Document 1: Request for Tenders
- Tender Document 3: The Framework Agreement, signed by all Phase 1 Suppliers on 11 December 2018
- Tender Document 7: call-off for Phase 3 - Field Testing
- Tender Document 8: The Specific Contract for Phase 3
- Tender Document 9: Field Test specifications
- Forms A", E", E" bis, F" and G"

All stipulations in the previous PCP Request for Tenders documents remain valid unless stated differently.

To submit an eligible Tender, the Tenderer shall sign and submit Forms A", E", E' bis, F" and G" to the Request for Tender. The use of these Forms is mandatory.

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 780371.

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IMPORTANT:

Summary of changes in Tender Document 2'' compared to Tender Document 2':
- F1.4, F1.8: small additions to description
- F2.2: part of the requirement was removed
- F4.6: clarifications to description and added text to allow for remote software updates
- F4.7: from nice-to-have to must-have in Phase 3. Requirement elaborated
- F4.8: added requirement
- F5.1: REST protocol made into an example, no longer mandatory
- F5.8, F5.9: small additions for clarification
- F6.1: added requirement
- F7.1: part of the requirement was removed
- F7.10: addition for clarification
- F7.12: rephrased
- F7.15: addition to description
- F9.1, F9.2: rephrased to allow for maximum flexibility
- F9.3: Sentence removed to allow for maximum flexibility
- NFR1.11 and NFR 1.12: small addition for clarification
- NFR 2.1: added requirement
- NFR 2.4: addition for clarification
- NFR 2.5: added requirement
- NFR 3.2, 3.3, 3.5, 3.8: additions for clarification
- NFR 3.7 this requirement was removed

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1. Glossary / Definitions

API	**Application Programming Interface**
broadcasting	**to send data publicly available in real time**
C-ITS	**Cooperative Intelligent Transport Systems**
Control Room	**Physical space for operating a fleet of vehicles remotely**
Design Guidelines	**Guidelines and tips that should be noted during the design of the system or the vehicle**
“in operation”	**When the vehicles are running on the route, ready to take passengers, they are in operation**
Local	**Referring to events on the pilot site**
Protected Communication	**Radio-frequency communication that is protected from cyber attacks**
Redundant systems	**The duplication (or multiplication) of critical components or functions of a system with the intention of increasing reliability of the system, usually in the form of a backup or fail-safe, or to improve actual system performance.**
V2I	**Vehicle to Infrastructure**
V2V	**Vehicle to Vehicle**
V2X	**Vehicle to Everything**

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2. Functional requirements

The operation of the autonomous bus line is expected to include following components:

FUNCTION 1: FLEET MANAGEMENT SYSTEM

This function describes the technical framework that is needed for the system to integrate the single vehicles to the Fleet Management.

Requirements (must have):

1.1 Robust, low-latency and end-to-end protected communication channel between vehicle unit and fleet management system. If V2V communication is implemented, the communication channel of the V2V communication must adhere to the same security standards. The use of valid industry standards for implementation is encouraged.
1.2 Contingency plan and accident mitigation for the event of communication failure
1.3 Automatic data gathering from the route condition (congestion, accidents, road blocks)
1.4 Automatic rerouting of the vehicle (human operator must confirm route selection). Remote operator must be able to send new missions to the vehicle remotely.
1.5 Deciding which bus-stops to stop on, within a fixed route, according to passenger demand
1.6 Possibility to stay on a terminus-type of station for a predetermined period of time or until prespecified time.
1.7 Real-time information of the fleet units statuses available for the operator
1.8 Implement the Fleet Management Systems Interface Standard (FMS-Standard), or a similar standard.

Requirements (nice to have)

1.9 Routing on the fly to go beyond fixed routes (within pre-specified area of operation), according to passenger on-demand requests
1.10 Open API for 3rd party integration for passengers to call the bus to their position, along bus line route according to passenger demand
1.11 Gathered data should be open standard

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FUNCTION 2: CONTROL ROOM FUNCTIONS AND REMOTE OPERATION

The **remote driving** is expected to be needed in a limited number of situations and general exceptions management when the vehicles are on the streets. Remote driving means a **remote driver person** in a control room takes over one vehicle in time as the designated driver. The expected situations for this include driving over difficult traffic conditions and difficult situations, as well as driving the vehicle to outside of traffic in emergencies.

The **maintenance of the fleet,** for example charging, fixing and storing of the vehicles, is expected to be directed from the control room, but performed on the field by field experts.

Please note: Radio-frequency communication methods are not defined in this document. Freedom of design is left for the Suppliers.

The Function 2 requirements stated below are expected to be carried out by the company providing the solution (service may be subcontracted, if proper training is ensured).

Requirements (must have)

2.1 Remote driving communication latency (see Function 1) that is suitable for remote operation of the fleet vehicle, for example including low enough latency in network communications as well as video encoding/decoding.

2.2 In case of loss of communications between vehicle unit(s) and Fleet Management System or Remote Control System, vehicle unit(s) must be autonomously able to seize operation without compromising safety.

2.3 The system needs to alert the remote driver person when the vehicles need to be taken over for manual driving. System needs to ensure safe operation (halt in a safe place, not obstructing traffic, if possible) even in the event of lag in the taking over of the vehicle.

2.4 Only fleet management operators (with proper credentials and training) must be able to interfere with the fleet. Amount of operators available in remote operating facility must be sufficient that safety of operations is guaranteed even in unexpected situations (medical emergency etc.)

2.5 Operators must be physically and mentally able to perform operating tasks and all operators must undergo training to be allowed to participate in the fleet management.

2.6 Visual presentation of real-time camera feed, location, and other required vehicle sensor data from each of the vehicles in one control dashboard. Critical vehicle data (vehicle ID, speed, direction, location, status, sensor data, camera feed, etc.) should be logged for reviewing purposes (in case of an accident etc.). Data should be available for logging in sufficient intervals (e.g. 10 minutes before an emergency stop).

2.7 24/7/365 operational capability for the system. For the field trial in Phase 3, the control room operation is expected to be managed during the operative hours only, and equipped with at least 2 persons capable and allowed to drive the vehicles remotely.

2.8 Visual representation of buses on their respective routes

2.9 Capability of emergency stopping one or all of the buses quickly

2.10 Rigorously tested and validated safety against cyber attacks

2.11 Mission-critical system have to have redundant system in case of a single system failure. In case of complete system failure, fleet vehicles must have sufficient edge intelligence to be able to shut down operations safely.

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Requirements (nice to have)

2.12 The system can predict the required manual driving for the remote driver person in advance, based on traffic situation

FUNCTION 3: CITY TRAFFIC CONTROL SYSTEM AND TRAFFIC INFRASTRUCTURE INTEGRATION

This function relates to the integration to cities' traffic control system and integration to cities' real-time traffic systems, including traffic light and congestion status. In case of complex V2I-implementation (e.g. traffic light intersection, drawbridge, barriers), a failure of integration needs to seize the operation safely.

Requirements (must have)

3.1 Ability to receive and react upon traffic light status (traffic light systems currently in place in the partner cities are described in Annex 2 to this document)

3.2 Ability to react upon traffic flow altering systems (barriers, drawbridges, changing traffic signs, human conducting traffic).

3.3 Design must incorporate a plan to accommodate a change in traffic management, for example in a situation where a police or a road worker is controlling the traffic.

Requirements (nice to have)

3.4 Ability to receive and react upon road condition (friction, wetness, etc.) data, if available

3.5 Two-way communication interface with pilot cities' traffic control systems, if such a system exists in said cities

3.6 C-ITS V2I -standards readiness and compliance (in progress)

3.7 Ability to communicate with local, bespoke, traffic flow altering systems (automatic barriers, changing traffic signs etc.)

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FUNCTION 4: MAINTENANCE AND INCIDENT MANAGEMENT

On-site fleet and incident management work means charging and storing the vehicles, other required maintenance of the vehicles, and management of field accidents and incidents. It also includes transporting the vehicles from the storing location to the pilot area for daily operations where this is needed.

Pilot sites will provide storage space suitable for the vehicle fleet (for suitability, see Function: Vehicle Requirements). The space will be equipped with electricity, heating, water and generic wifi. Companies can also provide their own solution for vehicle storage and depot during the night and maintenance (e.g. mobile storages). Charging fees must be covered by the consortium.

In FABULOS this will be taken at Phase 3 field testing.
See NFR1 on safety & technical maturity for requirements related to e.g. accidents & incidents management plan and cooperation with emergency services.

Requirements (must have)

4.1 Charging systems for all of the fleet, allowing to fully charge the vehicles during the non-operative hours.
4.2 If the solution requires on-street or bus-stop charging during the operative hours, the company needs to provide this system, its installation, and the required electricity.
4.3 Maintenance capability for fleet maintenance (repair work, tools, upkeep, cleaning etc.)
4.4 Local Incident Response Team for each pilot site (at least one person available to respond to emergencies and maintenance needs on the field during the operative hours)
4.5 A well-designed interface for the passengers to communicate with the remote operator in case of need.
4.6 System must have safety measures to ensure that the software updates are either done physically on-site via physical interface by trained staff or in comparably safe fashion.
4.7 Charging system (or vehicle on-board system) must gather data about the amount of energy charged (kWh) to each vehicle. Data must be available during desired reference periods (within one hour accuracy, presented by the procuring partners) and be separate for each pilot. The data must be given within one week of each request of the procuring partners.
4.8 Data should be made available on fuel consumption (l) during the pilots if used for heating / cooling

FUNCTION 5: INTEGRATION TO THE CITIES' PUBLIC TRANSPORT SYSTEMS

The fleet should be able to communicate with cities' public transportation systems.

Requirements (must have, Phase 3)

5.1 Open digital API for the control system that provides the real-time vehicles location (e.g. REST-protocol)
5.2 Feature development to include the vehicles to local public transport route planner software (for example Google, Digitransit)
5.3 Integration to local public transportation ticketing systems needs to be planned out and

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presented.

5.4 Access for the designated local transport authority or municipality to install small equipment into the vehicles (such as sensors and info screens), if the installation is possible in terms of power management and installation space.

Requirements (nice to have, Phase 3)

5.5 Bus status broadcasting (amount of passengers aboard, taken route, etc.)

5.6 On-demand route broadcasting

5.7 Integration to private MaaS operators systems and services

5.8 Possibility to have information / advertisements displayed for the passengers

5.9 Plan on how to install public transportation system ticketing equipment. Actual equipment does not need to be installed physically for the field tests.

5.10 A reservation for additional electrical components in the vehicle design, for ticketing systems to be installed with minimum ease (e.g. piping, power supply, surfaces for mounting points).

FUNCTION 6: TRAFFIC SITUATION CAPABILITIES

This Function defines the Traffic Situation Capabilities which the solution's vehicle unit must fulfill safely in the end of Phase 2 in order for the consortium to pass to Phase 3. The traffic situations that can be expected in the Field Test Phase are described in more detail in Annex I to this document.

Requirements (must have), Phase 2

6.1 The vehicle needs to be able to continue on its route by diverting the trajectory around an object that is blocking the initial trajectory.
This function is considered fulfilled if the vehicle can make the overtaking either at speed or after stopping behind the obstacle first. The vehicle needs to have a predefined safety area in which the diversion of the trajectory must happen.
Overtaking must be done in a safe fashion or not at all.
The operator needs to be made aware of the impending overtaking procedure and the operator needs to approve the maneuver before the start.

FUNCTION 7: VEHICLE AND FLEET REQUIREMENTS

Vehicle fleet of autonomous minibuses (in FABULOS either providing them as consortium partner, or leasing/procuring them from the autonomous bus vehicle manufacturers).

During Phase 2 the vehicle unit is not required to achieve the technological level necessary for Phase 3. To show the systematic approach and how the solution works, a substitute vehicle (older generation bus, technology mule or prototype) may be used and the fleet management system can be shown with computer simulated vehicles.

FABULOS is not a vehicle procurement project but takes a systematic approach, with a focus on the all-inclusive solution that can manage automated fleets as part of cities' public transportation

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systems. Therefore, Suppliers have some freedom in the constellation of the fleet: vehicles in the fleet do not need to be identical. However, each vehicle must meet the must have requirements (Phase 3).

Requirements (must have), fleet configuration

7.1 Fleet of min. 3 vehicles (in order to validate the fleet operations)
7.2 Each vehicle should have space for at least 8 passengers (phase 3).
7.3 Effective use of road space per passenger (Vehicles' road surface space required per passenger needs to be at least 25% less than with private cars)

Requirements (must have in Phase 2 and Phase 3), vehicle units

7.4 Electrically driven
7.5 Emergency stop buttons inside the vehicle
7.6 Remote stop (operated outside of the vehicle)
7.7 Automated and manual mode with onboard controller
7.8 Able to do at least 20 km/h

Requirements (nice to have in Phase 2, must have in Phase 3), vehicle units

7.9 Seating and standing places (if standing places are allowed by the local legislation) in each of the vehicles
7.10 Vehicle must be able to be operated safely with remote supervision without safety person on board. Even in cases where a safety person is required by law to be on board, the basic functions (start/stop/navigation etc.) of the bus need to be either automatic or operated remotely.
7.11 Charging must be possible in operating temperatures (see function 8)
7.12 Means of access for disabled people must be provided in at least one of the vehicles of the fleet (e.g. wheelchair ramp)
7.13 Space for wheelchair (or prams) in the passenger area, safe attachment system available
7.14 The interior heating / cooling system (A/C) must be able to maintain 20 °C temperature inside the vehicle in operating temperature during operating hours. Please note: In extreme temperatures, a liquid fuel system for heating and cooling can be used.
7.15 Seat belts for every seat, as well as emergency exits when mandated by national traffic safety authorities
7.16 Remote camera feed from outside (360 degrees) and inside cameras and access to this data stream
7.17 The vehicle units should be able to be stored outdoors when not in operation
7.18 Possibility to use winter tires suitable for (harsh) winter conditions
7.19 Turn signals to work according to real needs of driving (turn signal to start indicate before turning and when arriving to and leaving from a bus stop)
7.20 Sufficient energy storage or charging method to complete daily operation
7.21 Vehicle must notify the remote operator if the maximum number of passengers is exceeded
7.22 The operating temperatures and weather conditions mentioned in Function 8 and their potential impact on the vehicle should be taken into account (e.g. accumulating snow and freezing water with strong winds, consequences for drivetrain, sensor covers, door action, windows seals, plumbing, etc.)
7.23 The system should be able to perform in (and withstand the extra wear and tear caused

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by) challenging geographical conditions (e.g. steep inclines)

Requirements (nice to have in Phase 3), vehicle units

7.24 Four-wheel drive (not continuous) *(please note the must-have requirement about geographical conditions)*
7.25 Multiple steering axles
7.26 Wireless charging.
7.27 Small enough turning radius to operate within urban streets

FUNCTION 8: VEHICLE OPERATIONAL REQUIREMENTS

These requirements define how the vehicle needs to perform while operating. These requirements are to be taken into consideration in Phase 3.

Requirements (nice to have in Phase 2, must have in Phase 3)

8.1 Operating temperature from -15 to +40 °C
8.2 Driving in autonomous mode at least 90% of driving time (while in operation)
8.3 Can be operated on fixed routes stopping on every predefined bus stop (metro mode)
8.4 Can be operated on fixed routes stopping on predefined chosen bus stops (passenger chooses a bus stop where to stop while inside the bus)
8.5 Can be operated on fixed routes stopping on predefined bus stops by outside request of the passenger (e.g. fixed request button at the bus stop and/or mobile app)
8.6 Operational velocity the vehicle must be able to achieve in autonomous mode on any urban public road (considering local traffic regulations, speed limits, weather and environmental conditions and characteristics of the road): 30 km/h
8.7 Must be able to operate in following conditions:
- heavy rain
- strong winds
- sunshine (bright and low)
- light fog and mist
- light snowfall
- icy and low friction conditions
- small amount of dust or light debris (leaves etc.) on the road

Requirements (nice to have, Phase 3)

8.8 Operating temperature from -25 to +50 °C
8.9 Operating in adverse weather conditions:
- heavy snowfall
- thick fog or mist

8.10 Can be operated on fixed routes stopping anywhere on the route by on-demand request from inside or outside the bus (e.g. mobile app) with safety considered
8.11 Operational velocity the vehicle must be able to achieve in autonomous mode (considering local traffic regulations, speed limits, weather and environmental conditions and characteristics of the road): 50 km/h

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FUNCTION 9: DEPLOYMENT, SETUP AND SERVICE

The providers are expected to operate the bus service in Phase 3 in a close to commercial quality level (with the exception of force majeures) .

Deployment and setup of the route is one key element in getting the robot bus to run on the streets. Routes need to be planned in such a way that in case of failure in the integration with traffic control system and traffic infrastructure, it will not compromise operational safety.

Routes, planning, stakeholders and permission processes are described in more detail in Tender Document 9 - Field Test Specification.

Requirements (must have)

9.1 Two pilots per Supplier in two Procuring Partner cities in Phase 3.
9.2 In Phase 3: Operative hours: at least 6 hours per operating day per pilot.
9.3 In Phase 3: Minimum of 50 operative days per pilot site (not including setting up / testing days).
9.4 The company must offer deployment and setup on decided pilot routes in reasonable time in Phase 3 (field testing).
9.5 Changes in traffic infrastructure and arrangements must be kept at a minimum.
9.6 Cost of infrastructure changes (for the piloting and to return to status quo after piloting has ended) specifically needed to run the solution are covered by the deploying company. Electricity costs are covered by the procuring partners.
9.7 The offer must include all the necessary parts, accessories and measures to setup, deploy and operate the vehicles on indicated route taking into account descriptions in the other function requirements.

3. Non-functional requirements

The service that is provided will need to fulfill these overarching *non-functional requirements* to stay within the scope of this project

NFR 1: SAFETY AND TECHNICAL MATURITY

The vehicle solution that is carrying passengers must offer passive and active safety measures that ensure safe travel for the passengers. Personal safety for both the passengers and other people exposed to the vehicles needs to be a top priority in all of the consortium's actions. Consortia can be eliminated from the process if safety issues are overlooked.

Requirements (must have in Phase 1)

NFR 1.1 Consortium must create a document detailing the System Architecture.

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Requirements (must have in Phases 2 and 3)

NFR 1.2 Open API or other communication channels must be safe and secure by design.

NFR 1.3 Open interfaces must be separated from mission critical systems.

NFR 1.4 Verifying that the system has sufficient protection both in the physical and virtual interfaces against cyber attacks, the system should be subjected to a hacking attack by an external company/organisation with proper credentials of such validation methods. Consortiums are also encouraged to set up a bug bounty system and subjecting the system to a hackathon-type of hacking event. Remote operation and fleet management systems must pass external validation for cyber safety by guidelines of National Cyber Security Authorities.

Phase 2 (must have)

NFR 1.5 System Architecture document needs to be verified by a 3rd party validator.

NFR 1.6 All code run in the system needs to be signed.

NFR 1.7 Consortium must devise a Safety Plan & Risk Assessment, detailing at least (please note the above overall requirements about safety!):

- mission-critical systems
- redundancy of mission-critical systems and components
- risk analysis of different problematic scenarios (e.g. connection loss, power loss, radio frequency interference, physical malicious attacks against vehicle units, cyber attacks etc.)
- contingency plan for system failure (single subsystem or complete system)
- level of edge intelligence of the vehicle unit and reaction to problematic scenarios without remote operator intervention
- safety guidelines for emergency services (including a short training)(template will be provided)
- analysis of fire safety of the vehicle and other physical systems and installations
- analysis of occupational hazards (high-voltage, chemicals, risk of injury etc.)
- risk of vandalism
- environmental safety

NFR 1.8 The Safety Plan & risk Assessment should be verified by an Independent Safety Assessor (ISA)

NFR 1.9 Companies need to have an Accidents & incidents Management Plan devised in case of unforeseen circumstances (this may be together with the safety plan & risk assessment).

NFR 1.10 Crisis Communication Plan should be devised, with clear Chains of Command & Communication that will be followed should the situation arise.

Phase 3 (must have)

NFR 1.11 Questionnaire template from Emergency Services must be filled (provided by the Procuring Partners to the Suppliers) before the start of the first pilot.

NFR 1.12 Before the start of the first pilot: at least one training for local emergency services by the supplier about safety features of the vehicle in all cities where the consortium conducts the field tests. The procuring partners will select/invite the group of participants and provide a location for the training.

NFR 1.13 Vehicle behaviour must be monitored in case of anomalies (due to software errors,

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	hacking, interference etc.) constantly during the use, defective systems must be removed from traffic and audited immediately.
NFR 1.14	Risk Assessment for Public Roads and Technical Specifications of the vehicles must be submitted (a guideline will be provided)
NFR 1.15	Vehicle units should be equipped with fire extinguishers and first aid kits.
NFR 1.16	System must fulfill the European standards for Electro-Magnetic Compatibility (EMC)

NFR 2: SOCIETAL MATURITY

As this is a technical R&D project and not a full-scale implementation, the focus should be on the technological development of the solution, not on the assessment of its impacts on cities or society. However, a user-centric approach is important in all phases of the PCP. Therefore, we have identified elements that should be taken into account inside the vehicles or in the service as a whole to measure and encourage user acceptance.

Requirements (must have in Phase 3)

NFR 2.1	The Supplier is expected to carry out at least one user satisfaction / acceptance survey among a predetermined minimum number of passengers during the Field Testing. Procuring Partners will carry out before and after surveys in their respective cities. All surveys will consist of several mandatory questions (equal for all pilot sites) and the option to add own questions. Disabled people should be part of the survey group.
NFR 2.2	(Frequently Asked) Questions and Answers document should be devised for public and press use.
NFR 2.3	Communication and interaction between passengers and people outside the bus (social media, virtual or manual feedback window in a bus, expression of feelings during the trip). The bus should be able to give out a signal or a message (e.g. showing a message, blinking lights or sounding the horn) to road users in order to indicate that the bus can not continue on its path if there is an obstacle blocking the trajectory (or if there are some other things to communicate with the other road users).
NFR 2.4	The design of the bus gives citizens of the (pilot) area a feeling of ownership. The vehicles are required to have mandatory EU and FABULOS logos. Forum Virium Helsinki will provide these.
NFR 2.5	The consortium should enable and encourage cooperation with existing local public transport operators, traveller organisations and research institutes (for example local universities) to conduct (additional) user acceptance studies in order to evaluate societal uptake of the innovation.
NFR 2.6	Contacting and informing stakeholders and citizens in the testing area, together with the Procuring Partner where the Field Test takes place.

NFR 3: LEGAL MATURITY

The solution is expected to fulfill the legal framework of piloting cities. See **Annex 2** to this document for the current status in the country of each Procuring Partner.

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It is the responsibility of the companies in Phase 2 and Phase 3 to acquire the required licenses and insurances for their operation. The pilot sites' experts and transport planners will contribute to this process from previous experiences and route finding perspective, but the ultimate responsibility to be able to acquire licenses and insurances is on the company.

Requirements (must have)

NFR 3.1 The solution must comply with applicable, country-specific legislation in the number of passengers the bus can carry.

NFR 3.2 Licensing of the operator must fulfill local legislation (e.g. related to bus driver permits, special remote operator licenses, passenger and goods transport licenses)

NFR 3.3 Obtaining appropriate licenses and/or exemptions for the vehicle in the countries where the Field Testing takes place

NFR 3.4 The solution must take into account different legislation in the number of operators needed to oversee the vehicles

NFR 3.5 All legally required approval for open road testing

- Governmental agencies
  - *Police*
  - *Traffic safety authority (e.g. in relation to emergency exits and accessibility)*
- Land / route owners (transport infrastructure authority, cities)
- Other mandated stakeholders

NFR 3.6 All legally required insurances for open road testing

~~NFR 3.7 Software driving license (e.g. Netherlands Model), if applicable, must be passed~~

NFR 3.8 All data should be handled according to legislation

- Owner of the data is the supplier
- FABULOS project is the data processor. This means that the FABULOS procuring partners do not own the data but have full access to it. The data should be provided to them (on request) by the Supplier in a secure way.

Requirements (nice to have)

NFR 3.9 Additional insurance to cover any damages for the vehicle (kasko)

Annex 1: Questionnaire from Emergency Services (part of NFR 1.11 and NFR 1.12)

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Annex 2 to Tender Document 2'': Questionnaire from Emergency Services

Part of the Phase 3 must-have Non-Functional Requirements of FABULOS are NFR 1.11 and NFR 1.12.

NFR 1.11: Questionnaire template from Emergency Services must be filled (provided by the Procuring Partners to the Suppliers). **>> This document.**

NFR 1.12: At least one training for local emergency services by the supplier about safety features of the vehicle in the particular cities where consortium will conduct their pilots. The procuring partners will select the group of participants and provide a location for the training. **>> to be held before the start of each pilot.**

Below is a list of questions that the emergency services, the fire brigade, ambulance services and police have in relation to the FABULOS field tests. Consortia are required to complete this list (NFR1.11) at least one week before the training of the Emergency Services (NFR1.12).

A) Energy system:

- What kind of markings are there on the battery? Are they visible easily?
- Does the energy carrier or fuel cell switch off automatically via the board computer or SRS unit?
- Does the energy carrier or fuel cell switch off automatically in case of leakpower detection?
- Is it clearly visible from outside the vehicle that the energy carrier or fuel cell is switched off?
- Can the energy carrier or fuel cell be switched off via a universal kill switch?
- Is the internal and external temperature measurable (thermal runaway indication)?
- Is there an internal extinguishing system or is external extinguishing / cooling necessary in the case of a thermal runaway and is the energy carrier or fuel cell accessible from outside the vehicle? Is there a hatch for extinguisher?
- Is there thermal insulation between energy carrier or fuel cell and the passenger side?

B) Safety system

- Do airbags and belt tensioners remain active?
- Are the safety systems to be secured for example with an airbag cover?
- Are there alarm lights? When do they turn on?
- Do the doors open automatically or not automatically? Does this depend on the road section (e.g. if there is passing traffic)?
- Is it visible from outside the vehicle whether the safety system is still active? How can this be disabled?
- Does the vehicle choose a safe road location position, if still possible, after an accident?
- What is the reaction of the vehicle after pressing the emergency stop button; does the vehicle choose a safe road location?
- Does the safety system give instructions to the passengers? If so, which instructions before departure and which in the event of an accident?
- Does the safety system make a registration from before and after an accident?
- How does the vehicle react when it is cut?
- Is the vehicle movable after an accident (chassis still in good condition)?
- Can passengers stop the vehicle in case of emergency? How does the vehicle brake/What is the braking intensity?

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C) Communication system

- After an accident, does the vehicle provide the following data and can emergency services access this data?
  - Vehicle location?
  - Number of passengers (by seat occupancy)?
  - Camera images from inside and outside the vehicle?
  - Status and temperature of the energy carrier or fuel cell?
  - Crash- or delay forces that have been released after the accident and the direction of the forces?
- Is there a kind of SOS button if a passenger becomes unwell?
- Is communication possible between vehicle and services such as E-call after pressing SOS button?
- Is communication possible with the passengers?
- Is there a contact person?
- Is data communication encrypted and secured?
- Update of software on fixed location or mobile and how is this secured (data leak)?

D) Vehicle construction

- Are multiple types of materials used interchangeably as cage construction (boron steel and carbon fiber)?
- Is the inner cover easy to remove in order to get to the safety systems?
- Can parts such as doors be removed without tools by using split- or breakpins?
- How can passengers evacuate the vehicle if the doors are blocked/not functioning (emergency exits?)

E) General

- Is the vehicle recognizable from the outside that it is an autonomous vehicle?
- How can the emergency services know whether the automated driving system is engaged/disengaged?
- How does the vehicle react to approaching emergency services?
- How can the vehicle be stopped from the outside?
- Does the vehicle have rescue sheet available?
- Does the vehicle have a fire extinguisher and a first aid kit on board?
- What general safety features does the vehicle contain?
  - Airbags?
  - Seat belts?
  - Emergency hammer / window tap?
  - Other?

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