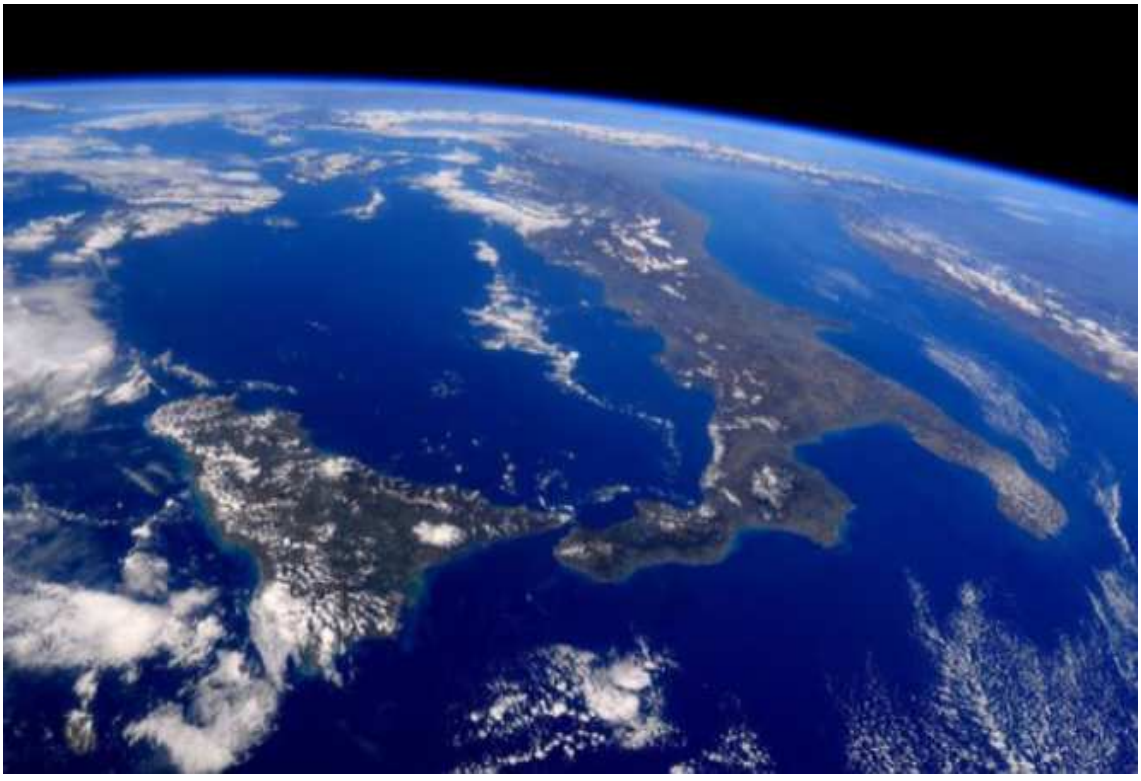
REGULATION

SUBORBITAL AND ACCESS TO SPACE OPERATIONS (SASO) REGULATION



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DOCUMENT CHANGE RECORD

Edition	Revision	Date	Reason for change
0.0	0	20/11/2023	First issue - Section I, II, III

Explanatory Note

This regulation contains the requirements a vehicle system operator has to comply with in order to be authorised to conduct suborbital operations or operations for access to space (e.g. launching into orbit) or re-entry from orbit. Crewed and uncrewed operations, with or without occupants on-board, are in the scope.

This regulation is composed of five sections from Section I to Section V. Scope, applicability, definitions and general requirements valid for each type of operations are set forth in Section I and II. Suborbital operations requirements are set forth in Section III, while launching into space and re-entry from orbit requirements are set forth in Section IV and V respectively. Performance-based flightworthiness requirements are set forth in Annex 1 of this regulation and are applicable to vehicles with occupants on-board, irrespective of the type of operation carried out. Orbital operations after the entry into orbit or before deorbit are not in the scope of this regulation.

For the time being only Sections I, II and III, and Annex 1 are available. Sections IV and V are under development and will be added into the regulation in a later stage.

This regulation follows a risk-based and operation-centric approach aimed at issuing to the vehicle system operator a single authorization, either a licence or an experimental permit, that considers the operation as a whole and covers all the relevant domains. Moreover the requirements are performance-based wherever possible.

Two main domains are addressed, namely the public safety (aka third party safety) and the occupants safety, While occupants safety requirements are performance-based, due to the need to cover different classes of vehicles, the public safety requirements are more prescriptive and quantitative.

In order to allow innovation and to take into account different vehicle system architectures and solutions, the Annex 1 of this regulation provides flightworthiness performance-based requirements for the design of vehicle system intended to carry occupants on-board, which shall be used to develop detailed consensus standards tailored to the specific categories of vehicle systems. In other words occupants' safety requirements are objective requirements whose aim is to provide mandatory guidance to develop the consensus standards that may be used by the applicant to design the vehicle, provided they have been approved by the authority. In general,

consensus standards will be approved by the authority if they are recognized in compliance with the objective requirements of this regulation.

This regulation would like to be adaptive in principle, and as such it will be updated as necessary following the evolution of the sector and based on the data and experience coming from the operations and also gathered from the regulatory sandboxes that may be implemented for possible specific types of operations that may not completely fit the current regulation.

The main reference taken into consideration in developing this regulation are the following:

- *ENAC, Commercial Suborbital Transportation Regulatory Framework – Reference Operational Scenario (ROS), CST-WG1-ROS-01 Ed. 1.1 of 7 November 2018 (ROS-01)*
- *EASA CS-23 Amendment 5.*
- *French Space law (loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales) and relevant Arrêté du 11 juillet 2017 modifiant l'arrêté du 31 mars 2011 relatif à la réglementation technique en application du décret n° 2009-643 du 9 juin 2009 relatif aux autorisations délivrées en application de la loi n° 2008-518 du 3 juin 2008 relative aux opérations spatiales*
- *UK Space Industry Act 2018 (UK SIA)*
- *US CFR Title 14, Volume 4, Chapter 3, Parts 401, 405, 406, 413, 414, 437, 440, 450, 460*
- *FAA Recommended Practices for Human Space Flight Occupant Safety, Version 1.0 of 27 August 2014 (RP-HSP)*

Summary

SECTION I - GENERAL

1 INTRODUCTION AND SCOPE

SASO-GEN.5 General

(a) Any person that intends to carry out a suborbital operation, a launching into orbit operation, or a re-entry from orbit operation to/from Italian territory and in the airspace under Italian responsibility shall obtain an operation authorization issued by ENAC.

(b) This regulation provides requirements a vehicle system operator has to comply with in order to obtain an operation authorization for one of the following type of operations:

(1) a suborbital operation,

(2) a launching into orbit operation, or

(3) a re-entry from orbit operation.

(c) An operation authorization is issued on the basis of a holistic, operation-centric, risk-based and performance-based approach that shall cover all the foreseeable hazards related to the operation, including at least those related to design, production, maintenance, operations, training, crew skill and medical aspects.

(d) An operation authorization will be issued when the applicant substantiates and provides to ENAC with a sufficient level of confidence that the hazards related to the operation are controlled so as to reduce the risks to an acceptable level, as required by this regulation.

(e) The risks considered in this regulation are the following:

(1) risks for the public on the ground, at sea, in the air and in space;

(2) risks for critical assets and infrastructure on ground, at sea, in the air and in space, identified by relevant governmental bodies;

(3) risks for people involved in the operation;

(4) risks for people on-board the vehicle (occupants), if any.

SASO-GEN.10 Scope of the operation

For the aim of obtaining an authorization in accordance with this regulation, an operation may have one of the following scopes:

(a) Research and Development for carrying out experimental activities related to the development of the vehicle system and related equipment and infrastructure.

(b) Specialised operations, either commercial or non-commercial.

SASO-GEN.15 Operator responsibilities

(a) The vehicle system operator is the unique responsible for safely and securely conducting all phases of an operation for which an operation authorization or an experimental authorization has been issued by ENAC, except for those aspects and responsibilities otherwise allocated to a different subject by applicable ENAC regulation or other applicable European regulations or National laws and regulations.

(b) The vehicle system operator must enter into an agreement, as necessary, with:

(1) spaceport operator or the otherwise identified take-off/launching or landing/re-entry site operator;

(2) Air navigation Service (ANS) providers;

(3) Space Weather service providers (if not a MET Service Provider);

(4) Maritime authorities;

(5) Search and rescue authorities;

(6) Other relevant authorities and service providers.

SASO-GEN.20 Means of compliance and equivalent level of safety

(a) Guidance Material (GM) and Acceptable Means of Compliance (AMC) to the requirements of this regulation are published by ENAC as guidelines to this regulation.

(b) When a vehicle system operator wishes to use an alternative means of compliance (ALTMOC) to the acceptable means of compliance (AMC) to establish compliance with this regulation, it shall, prior to implementing it, provide ENAC with a full description of the alternative means of compliance and an assessment demonstrating that the applicable requirements are met if applied. The vehicle system operator shall implement these alternative means of compliance subject to prior approval by ENAC.

(c) Every provision or requirements of this regulation may be complied with by using compensating factors, conditions, limitations or alternative means that ensure an Equivalent Level of Safety (ELOS) to that provided by relevant provisions and requirements of this regulation and the associated GM & AMC, provided they are agreed with, and approved by, ENAC.

SASO-GEN.22 Types of operation authorizations

(a) An operation authorization may be either an vehicle system operator licence, an experimental permit or a Foreign Country Operator Authorization (FCOA).

(b) A vehicle system operator licence may be issued for operation for the scope of carry out specialised operations, either commercial or non-commercial, to be performed in a certified spaceport (e.g. “GROTTAGLIE” spaceport).

(c) An experimental permit:

(1) is issued for an experimental operation for the scope of Research and Development related to the vehicle system or for other scopes for which ENAC consider a vehicle system operator licence is not appropriate.

(2) includes specific provisions, conditions and limitations for the launching/take-off or re-entry/landing site. Specific conditions and limitations are defined and approved by ENAC on a case-by-case basis and are associated, as an integral part, to the experimental permit.

(d) A Foreign Country Operator Authorization (FCOA) or equivalent may be issued by ENAC to a vehicle system operator with a valid licence issued by a foreign country with which ENAC or the Italian Government has entered into a bilateral agreement, in accordance with the associated Technical Implementation Procedures and any additional conditions and limitations deemed adequate by ENAC in order to comply with the requirements of this regulation.

2 APPLICABILITY

SASO-GEN.25 Applicability

(a) Section I and Section II of this regulation applies to the types of operation specified at **SASO-GEN.5(a)**.

(b) Section III of this regulation contains specific requirements for obtaining a suborbital operation authorization.

(c) Section IV of this regulation contains specific requirements for obtaining a aero-launching into orbit operation authorization.

(d) Section V of this regulation contains specific requirements for obtaining a re-entry from orbit operation authorization.

2.1 SUBORBITAL OPERATIONS

SASO-GEN.30 Suborbital operation

A suborbital operation includes any activity related to a suborbital vehicle, carried out by an operator, manufacturer or service provider on ground or in flight -

(a) That is needed to safely and securely prepare and carry out a suborbital flight, including the implementation of contingency and emergency procedures, and

(b) That does not have the aim to send the suborbital vehicle, any portion thereof or any payload to outer space by placing them on an orbit around the Earth or escape from the Earth.

SASO-GEN.35 Type of suborbital operations

(a) A suborbital operation authorization may be issued to a suborbital vehicle system operator for a specific type of operation carried out with a specific type of suborbital vehicle.

(b) Suborbital operations may be:

(1) A-to-A, or

(2) A-to-B (point-to-point).

SASO-GEN.40 Types of suborbital vehicles

The type of suborbital vehicle and the related supporting systems, intended to be used in the operation must be unambiguously described and identified.

SASO-GEN.45 Types of suborbital operation authorizations

The types of suborbital operation authorizations are those referred to **SASO-GEN.22.**

SASO-GEN.50 Vehicle system operator licence

(a) A valid vehicle system operator licence authorises the suborbital vehicle system operator referred to in the licence to carry out suborbital operations as per the elements defined in **SASO-GEN-55(c)(1) to (6)** and in accordance with the relevant conditions and limitations including any allowed modification to the suborbital vehicle configuration, to the supporting infrastructure and to the assumptions on the basis of which the licence is issued.

(b) An undertaking shall be granted a vehicle system operator licence by ENAC provided that it complies with all the applicable requirements relevant to all phases of the operation; aforementioned requirements include those related to design, production, maintenance, insurance, crew licensing, medical aspects, payload characteristics, security issues and interface with the spaceport operator and infrastructure and relevant service providers and infrastructure.

(c) A vehicle system operator licence remains valid until its expiring date, as long as the undertaking complies with the provision of the present regulation and with any other applicable ENAC regulation, European regulation or National laws and regulations, and unless it is, due to any reason, suspended or revoked by ENAC.

SASO-GEN.55 Vehicle system operator licence categories

An vehicle system operator licence can be issued for one of the following categories and sub-categories

(a) Categories -

- CAT M - Manned
- CAT U - Unmanned

(b) Sub-categories -

- SUB-CAT 0 – Without participants on-board
- SUB-CAT 1 – With participants on-board (excluded training purposes)

- SUB-CAT 2 – Crew and/or participants training

(c) A single vehicle system operator licence can be issued to a suborbital operator for one specific combination of the following elements:

(1) Scope of operation per **SASO-GEN.10**

(2) Type of operations per **SASO-GEN.35**

(3) Type of suborbital vehicle per **SASO-GEN.40**

(4) Licence Category per **SASO-GEN.55(a)**

(5) Licence Sub-category per **SASO-GEN.55(b)**

(6) Take-off and re-entry/landing site(s)

(7) Conditions and limitations

SASO-GEN.60 Suborbital operation experimental permit

(a) The conditions under which a suborbital operation experimental permit can be issued are specified in Section III paragraph 3 of this regulation.

(b) An experimental permit can only be issued to a specific suborbital vehicle whose configuration is defined, approved, under control, and for a single flight or limited period or time, under specific conditions and limitations issued by ENAC.

(c) A suborbital operation experimental permit may include specific conditions and limitations for take-off/launching sites and for landing/re-entry sites different from spaceport certified in accordance with the related Reg. ENAC Spaceports [R2].

(d) A suborbital operation experimental permit is valid for the flight or for the period specified in the experimental permit, provided the vehicle system operator continues to comply with the conditions and limitations specified therein unless, due to any reason, it is suspended or revoked by ENAC.

SASO-GEN.65 Requirements for authorization

(a) To obtain and maintain an authorization for an operation with occupants on-board, the vehicle system operator shall comply with Section I, II and III of this regulation.

(b) To obtain and maintain an authorization for an operation without occupants on-board, the vehicle system operator shall comply with Section I, II and III of this regulation, except for Section III paragraph 1.2 which is not mandatory in this case.

2.2 ACCESS TO SPACE

[reserved]

2.3 RE-ENTRY FROM ORBIT

[reserved]

3 REFERENCES

[R1] Ministry of Infrastructure and Transport (current Ministry of Sustainable Infrastructure and Mobility), Address Act on the Development of a Sustainable Commercial Suborbital Transportation, Decree n. 354 of 10 July 2017.

[R2] Regulation for the Construction and Use of Spaceports (Reg. ENAC Spaceports)

4 DEFINITIONS

A-to-A flight - a suborbital operation carried out by a vehicle not intended to land at a destination different than (or far from) departure (launch/take-off site coincides with the return/landing site).

A-to-B flight - a suborbital operation carried out by a vehicle intended to land at a destination different than departure.

Aircraft Hazard Area (AHA) - Volume used to segregate air traffic from a launch vehicle, reentry vehicle, amateur rocket, jettisoned stages, hardware, or falling debris generated by failures associated with any of these activities.

Anomaly - any condition during licensed or permitted activity that deviates from what is standard, normal, or expected, during the verification or operation of a system, subsystem, process, facility, or support equipment.

Casualty - serious injury or death.

Casualty Area - the area surrounding each potential debris or vehicle impact point where serious injuries, or worse, can occur.

Catastrophic damage - loss of human life, immediate or deferred, or serious injury to persons (bodily injury, other irreversible damage to health, disability or occupational disease, permanent or temporary).

Coefficient of safety - the ratio between the permissible limit of a parameter characterising a system or element and its maximum value expected in nominal operation. Its value integrates the notion of dispersion specific to each concerned domain.

Command Control System - the portion of a flight safety system that includes all components needed to send a flight abort control signal to the on-board portion of a flight safety system.

Commercial suborbital flight/operation - a suborbital flight/operation carried out by a specific suborbital vehicle that carries people on-board as part of an operation of commercial suborbital transportation.

Commercial suborbital transportation - transportation of people and or goods through a suborbital vehicle, with or without on-board crew, for non-governmental civilian purposes.

Computing system safety item - any software or data that implements a capability that, by intended operation, unintended operation, or non-operation, can present a hazard to the public. A computing system safety item often contains several software functions assembled to meet a group of related requirements (e.g. an autonomous flight safety system (AFSS) or GPS).

Contingency Abort - a flight abort with a landing at a planned location that has been designated in advance of vehicle flight.

Countdown - the timed sequence of events that must take place to initiate flight of a launch vehicle or reentry of a reentry vehicle.

Crew - any employee or independent contractor of a licensee, transferee, or permittee, or of a contractor or subcontractor of a licensee, transferee, or permittee, who performs activities in the course of that employment or contract directly relating to the launch, reentry, or other operation of or in a launch vehicle or reentry vehicle. A crew consists of flight crew and any remote operator.

Critical asset - an asset that is essential to the national interests. Critical assets include property, facilities, or infrastructure necessary for national security purposes, high priority civil space purposes, or assured access to space for national priority missions.

Critical payload - a payload and essential infrastructure directly supporting such a payload that is a critical asset that:

(1) Is so costly or unique that it cannot be readily replaced; or

(2) The time frame for its replacement would adversely affect the national interests of the State of Italy.

Crossrange - the distance measured along a line whose direction is either 90 degrees clockwise (right crossrange) or counter-clockwise (left crossrange) to the projection of a vehicle's planned nominal velocity vector azimuth onto a horizontal plane tangent to the ellipsoidal Earth model at the vehicle's sub-vehicle point. The terms right crossrange and left crossrange may also be used to indicate direction.

Dangerous Goods - dangerous goods (DG) means articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the Technical Instructions approved and published by the International Civil Aviation Organisation or which are classified according to those instructions.

Degree of control - a computing system safety item's importance in the causal chain for a hazard, in either causing or preventing the hazard.

Deorbit - the flight of a vehicle that begins with the final command to commit to a perigee below 70 nautical miles (approximately 130 km), and ends when all vehicle components come to rest on the Earth.

Disposal - the return or attempt to return, purposefully, a launch vehicle stage or component, not including a reentry vehicle, from Earth orbit to Earth, in a controlled manner.

Downrange - the distance measured along a line whose direction is parallel to the projection of a vehicle's planned nominal velocity vector azimuth into a horizontal plane tangent to the ellipsoidal Earth model at the vehicle sub-vehicle point. The term downrange may also be used to indicate direction.

Effective Casualty Area - the aggregate casualty area of each piece of debris created by a vehicle failure at a particular point on its trajectory. The effective casualty area for each piece of debris is a modelling construct in which the area within which 100 percent of the population are assumed to be a casualty, and outside of which 100 percent of the population are assumed not to be a casualty.

Equivalent level of safety - an approximately equal level of safety as determined by qualitative or quantitative means.

Expected Casualty (Ec) - the mean number of casualties predicted to occur per flight operation.

Expendable launch vehicle - a launch vehicle whose propulsive stages are flown only once.

Experimental permit - an authorization designed for reusable launch vehicles that may be issued by ENAC in addition to a vehicle operator licence in order to allow experimental suborbital operations. A permit is valid only for a single launch operation.

Explosive Debris - solid propellant fragments or other pieces of a vehicle or payload that result from breakup of the vehicle during flight and that explode upon impact with the Earth's surface and cause overpressure.

Fatal injury - refer to art. 2, paragraph 5, of the **Reg. (EU) No 996/2010**.

Flight Abort - the process to limit or restrict the hazards to public health and safety, and the safety of property, presented by a launch vehicle or reentry vehicle, including any payload, while in flight by initiating and accomplishing a controlled ending to vehicle flight.

Flight Abort Rules - the conditions under which a flight safety system must abort the flight to ensure compliance with the safety criteria in this regulation.

Flight Corridor - an area of the Earth's surface with defined shape and dimensions, able to contain, with the required level of probability and confidence, any hazardous debris produced by the fall of a vehicle or its parts during the flight phases included in the suborbital operations.

Flight Crew - crew that is on-board a vehicle during a launch or reentry.

Flight Hazard Area - any region of land, sea, or air that must be surveyed, publicised, controlled, or evacuated in order to ensure compliance with the safety criteria in this regulation.

Flight Operation - The whole set of flight activities related to a vehicle, carried out from take-off/launch phase up to landing phase and vehicle securing; it includes post-flight operations.

Flight Participant - an individual, who is not crew and/or passenger, carried aboard a launch vehicle or reentry vehicle, who may have a specific role to perform non-essential activities. The role of the flight participants is normally related to a specialized activity to be carried out on-board during flight or on ground.

Flight Safety Limit - criteria to ensure that public safety is protected from the flight of a vehicle when a flight safety system functions properly.

Flight Safety System - a system used to implement flight abort. A flight safety system includes any flight safety system located on-board a launch or reentry vehicle; any ground based command control system; any support system, including telemetry subsystems and tracking subsystems, necessary to support a flight abort decision; and the functions of any personnel who operate the flight safety system hardware or software.

Foreign Country Operator Authorization (FCOA) - authorization for reusable launching or re-entry vehicles that may be issued by ENAC in addition to vehicle system operator licence issued by a foreign country with which ENAC or the Italian Government has entered into a bilateral agreement. The vehicle system operator shall comply with the Technical Implementation Procedures (TIP) associated to the existing bilateral agreement and any additional conditions and limitations deemed adequate by ENAC in order to comply with the requirements of this regulation and that are not covered by the concerned licence.

Ground crew - Any employee of a suborbital vehicle operator or of any of the contractors or sub-contractors of a suborbital vehicle system operator that performs ground activities directly related to launch/take-off, re-entry/landing or any other operation of the suborbital vehicle.

Hazard Control - a preventative measure or mitigation put in place for systems or operations to reduce the severity of a hazard or the likelihood of the hazard occurring.

Hazardous debris - any object or substance capable of causing a casualty or loss of functionality to a critical asset. Hazardous debris includes inert debris and explosive debris such as an intact vehicle, vehicle fragments, any detached vehicle component whether intact or in fragments, payload, and any planned jettison bodies.

High consequence events - incidents that could involve multiple casualties, massive toxic exposures, extensive property or environmental damage, or events that jeopardise national security or foreign policy interests.

Higher Airspace (HA) - A volume of the airspace typically above FL 550 where the Higher Airspace Operation (HAO) are carried out.

Higher Airspace Operations (HAO) - Operations carried out by various types of vehicles systems that operate within or transit through the Higher Airspace; they include:

- Supersonic flights;
- Hypersonic flights;
- A-to-A suborbital flight and A-to-B suborbital flights (including sounding rockets and aero launching operations into a suborbital trajectory)
- HAPS, stratospheric weather/scientific balloons, and other subsonic UAS, HALE operations.

In addition, vehicles systems will also transit through and interface with the airspace, they include:

- orbital operations for access to space (including aero-launching operations)
- and re-entry operations from space.

Horizontal spaceport - A spaceport specifically designed to exclusively host horizontal takeoff/launching and/or landing/reentry (HTOL) suborbital or orbital operations (e.g. National "GROTTAGLIE" spaceport).

Horizontal Take-Off and Landing (HTOL) - operations where vehicles systems or parts thereof depart (i.e. take-off or are launched) and arrive on the surface (land or re-enter) horizontally in the final phase.

Instantaneous Impact Point - A predicted impact point, following thrust termination of a vehicle or part of it, in a specific instant during flight.

Launch - an operation to place or try to place a launch vehicle or reentry vehicle and any payload or human being from Earth in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space. Launch includes the flight of a vehicle system and pre- and post-flight ground operations.

Launch Operator - a person who conducts or who will conduct the launch of a launch vehicle and any payload.

Launch or Reentry System - the integrated set of subsystems, personnel, products, and processes that, when combined together, carries out a launch or reentry.

Launch Site - the location on Earth from which an authorised/licensed launch takes place and necessary facilities at that location.

Launch Vehicle - a vehicle built to operate in, or place a payload in, outer space or a suborbital rocket.

Launch Window - a period of time during which the flight of a launch vehicle may be initiated.

Level of criticality - the risk posed by a computing system safety item, which is a combination of the severity of the hazards associated with the computing system safety item and the computing system safety item's degree of control.

Liftoff - any motion of the launch vehicle with intention to initiate flight.

Limits of a Useful Mission - the trajectory data or other parameters that bound the performance of a useful mission, including flight azimuth limits.

Maximum probable loss (MPL) - the greatest amount of money's loss for bodily injury or property damage that is reasonably expected to result from a permitted activity.

Mishap - any event, or series of events associated with a licensed or permitted activity resulting in any of the following:

(1) a fatality or serious injury (as defined in **Reg. (EU) 996/2010**);

(2) a malfunction of a safety-critical system;

(3) a failure of the licensee or permittee's safety organisation, safety operations, safety procedures;

(4) high risk, as determined by ENAC, of causing a serious or fatal injury to any flight participant, crew, government astronaut, or member of the public;

(5) substantial damage, as determined by ENAC, to property not associated with licensed or permitted activity;

(6) unplanned substantial damage, as determined by ENAC, to property associated with licensed or permitted activity;

(7) unplanned permanent loss of a launch or reentry vehicle during licensed activity or permitted activity;

(8) the impact of hazardous debris outside the planned landing site or designated hazard area; or

(9) failure to complete a launch or reentry as planned.

Neighbouring Operations Personnel - those members of the public located within a launch or reentry site, or an adjacent launch or reentry site, who are not associated with a specific hazardous licensed or permitted operation currently being conducted but are required to perform safety, security, or critical tasks at the site and are notified of the operation.

No-flight zone - a portion of a flight corridor that is required to be maintained free from people during the flight of a suborbital vehicle or a part of it.

Non-Commercial operation - any operation carried out by a suborbital vehicle system other than commercial one.

Nominal - in reference to launch vehicle performance, trajectory, or stage impact point, a launch vehicle flight where all vehicle aerodynamic parameters are as expected, all vehicle internal and external systems perform exactly as planned, and there are no external perturbing influences other than atmospheric drag and gravity.

Normal Flight - the flight of a properly performing vehicle whose real-time vacuum instantaneous impact point does not deviate from the nominal vacuum instantaneous impact point by more than the sum of the wind effects and the three-sigma guidance and performance deviations in the uprange, downrange, left-crossrange, or right-crossrange directions.

Normal Trajectory - a trajectory that describes normal flight.

Occupant – a flight crew individual, flight participant or passenger carried on-board a suborbital vehicle during flight.

Operating Environment - an environment that a launch or reentry vehicle component will experience during its lifecycle. Operating environments include shock, vibration, thermal cycle, acceleration, humidity, thermal vacuum, or other environments relevant to system or material degradation.

Operation Hazard - a hazard created by an operating environment or by an unsafe act.

Operation of a launch site - the conduct of approved safety operations at a permanent site to support the launching of vehicles and payloads.

Operation of a reentry site - the conduct of safety operations at a permanent site on Earth at which a reentry vehicle and its payload, if any, is intended to land.

Operator - a holder of a licence or other authorisation issued by ENAC.

Orbital Insertion - the point at which a vehicle achieves a minimum 70-nautical mile perigee based on a computation that accounts for drag.

Orbital operation - an operation in Earth's orbit or an operation whose aim is to place a vehicle system, or any portion thereof, or any payload or space object into an orbit able to circle the Earth or to escape from the Earth. It includes aero-launching operations into orbit and re-entry flight.

Passenger - a person who is on-board a vehicle utilized in a Higher Airspace Operations (HAO) by virtue of a contract of transportation concluded with the vehicle system operator, and who has no control or responsibility on the conduction of the flight, and does not perform any activity related to the operation.

Payload - an object that a person undertakes to place in outer space or to carry in suborbital operations, by means of a launch vehicle, including components of the vehicle specifically designed or adapted for that object.

Person - an individual or an entity organised or existing under the laws of a State or country.

Physical Containment - means (that) a launch vehicle does not have sufficient energy for any hazards associated with its flight to reach the public or critical assets.

Physical electronic storage - a physical device that can store electronic documents and files including but not limited to an optical disc, a memory card, a USB flash drive, or an external hard drive.

Pilot - a flight crew member who has the ability to control, in real time, a launch or reentry vehicle's flight path.

Populated area - means:

(1) an outdoor location, structure, or cluster of structures that may be occupied by people;

(2) sections of roadways and waterways that are frequented by automobile and boat traffic;

or

(3) agricultural lands, if routinely occupied by field workers.

Pre-Flight - means the period of time beginning when occupants are exposed to hazardous conditions from vehicle until flight begins; the pre-flight phase does not apply to the reentry operations.

Probability of Casualty (Pc) - the likelihood that a person will suffer a serious injury or worse, including a fatal injury, due to all hazards from an operation at a specific location.

Public - for a particular licensed or permitted launch or reentry, people that are not involved in supporting the launch or reentry and includes those people that may be located within the launch or reentry site, such as visitors, individuals providing goods or services not related to launch or reentry processing or flight, and any other operator and its personnel.

Reenter; Reentry - an operation to return or attempt to return, purposefully, a reentry vehicle and its payload, if any, from Earth orbit or from outer space to Earth.

Reentry Operator - a person responsible for conducting the reentry of a reentry vehicle as specified in a licence or other authorisation issued by ENAC.

Reentry Site - the location on Earth where a reentry vehicle is intended to return. It includes the area within three standard deviations of the intended landing point (the predicted three-sigma footprint).

Reentry Vehicle - a vehicle designed to return from Earth orbit or outer space to Earth substantially intact. A reusable launch vehicle that is designed to return from Earth orbit or outer space to Earth substantially intact is a reentry vehicle.

Reentry Window - an approved period of time during which the reentry of a reentry vehicle may be initiated.

Remote Operator - a crew member who

(1) has the ability to control, in real time, a launch or reentry vehicle's flight path, and

(2) is not on-board the controlled vehicle.

Reusable launch vehicle (RLV) - a launch vehicle that is designed to return to Earth substantially intact and therefore may be launched more than one time or that contains vehicle stages that may be recovered by a launch operator for future use in the operation of a substantially similar launch vehicle.

Risk - a measure that accounts for both the probability of occurrence of a hazardous event and the consequence of that event to persons or property.

Risk Control - See Hazard Control

Safety Critical - essential to safe performance or operation. A safety-critical system, subsystem, component, condition, event, operation, process, or item, is one whose proper recognition, control, performance, or tolerance, is essential to ensuring public safety and the safety of property.

Safety Margin - the ratio between the permissible limit of a parameter characterising a system or element and its expected maximum value in normal operation multiplied by the coefficient of safety.

Safety Requirement (Computing System Safety) - a computing system requirement or software requirement defined for a computing system safety item that specifies an attribute or function that presents, prevents, or is otherwise involved in a hazard to the public.

Serious injury - refer to art. 2, paragraph 17, of the **Reg. (EU) No 996/2010**.

Service Life - for a safety-critical system component, the sum total of the component's storage life and operating life.

Sigma - a single standard deviation from a fixed value.

Software Function - a collection of computer code that implements a requirement or performs an action. This includes firmware and operating systems.

Space debris - any non-functional human-made space object, including fragments and elements thereof, in Earth orbit or re-entering the Earth's atmosphere.

Space Traffic Management (STM) - means and rules to access, conduct activitiers in, and return from outer space safety, sustainably and securely.

Spaceport - A site on the Earth's surface whose infrastructure, facilities and equipment, as well as its technical requirements, are specifically dedicated to launch/take-off, re-entry/landing, or ground/flight operation of a suborbital or orbital vehicle system. The site is structured to allow all the necessary operations to execute a flight, including related systems maintenance and preparation to flight.

With respect to the purpose of operations, a spaceport may be classified as:

- suborbital spaceport,
- orbital spaceport, or
- multipurpose spaceport (for both suborbital and orbital operations).

With respect to the take-off/launching or landing/re-entry mode of the vehicle system or parts thereof operated within the spaceport, a spaceport may be classified as:

- vertical spaceport,
- horizontal spaceport, or
- multimode spaceport (for both horizontal and vertical operations).

Specialised operation - means any commercial or non-commercial operation where the vehicle is used for specialised activities other than Commercial Air Transport. For the purpose of this regulation, specialised operation means any operation involving access to Higher Airspace other than an experimental activity.

Suborbital Flight - the flight that follows the suborbital trajectory.

Suborbital Operation - The whole set of ground and flight activities related to a suborbital vehicle system, carried out within from/on an identified launching/take-off or re-entry/landing site (e.g. a spaceport), an operator, manufacturer or service provider infrastructure, or in flight, needed to safely and securely prepare and carry out a suborbital flight (including the implementation of contingency and emergency procedures) which does not have the aim to send the suborbital vehicle, any portion thereof or any payload to outer space by placing it on an orbit able to circle the Earth or escape from the Earth. It includes operations of sounding rockets and aero-launching vehicle systems into a suborbital trajectory.

Suborbital rocket - A rocket propelled suborbital vehicle.

Suborbital Spaceplane - A rocked propelled aircraft intended to fly a suborbital trajectory.

Suborbital Spaceport - A spaceport specifically designed for suborbital operation only. (Reg. ENAC Spaceports [R2]).

Suborbital System - All the ground and flight elements needed to safely and securely carry out a suborbital operation. It includes the suborbital vehicle system including the payload, the launch/take-off and re-entry/landing site infrastructure (the spaceport) along with any essential service infrastructure. It may also include the payload integration infrastructure.

Suborbital Trajectory - The intentional flight path of a vehicle or any portion thereof, whose vacuum Instantaneous Impact Point (IIP) does not leave the surface of the Earth, and that reaches high altitudes beyond the denser layer of the atmosphere, such that in a portion of it the vehicle is not able to develop sufficient aerodynamic forces to significantly affect the flight (attitude, control or flight performances) (ballistic flight).

Suborbital Vehicle System - A vehicle system one stage of it is intended to carry out a suborbital flight.

Suborbital Vehicle - A vehicle of a suborbital vehicle system, intended to fly on a suborbital trajectory.

Sub-Vehicle Point - the location on an ellipsoidal Earth model where the normal to the ellipsoid passes through the vehicle's centre of gravity.

System Hazard - a hazard associated with a system and generally exists even when no operation is occurring.

Tether System - a device that contains launch vehicle hazards by physically constraining a launch vehicle in flight to a specified range from its launch point. A tether system includes all components, from the tether's point of attachment to the vehicle to a solid base, that experience load during a tethered launch.

Third Party Liability - affects all organisations and concerns anything that can lead to legal and financial responsibilities for bodily injury or property damage to a third party that is reasonably expected to result from a permitted activity. Third-party liability insurance is a type of coverage that financially protects the involved organizations covering legal costs, medical bills for bodily injuries, and repair costs for property damage.

Toxic Hazard Area - a region on the Earth's surface where toxic concentrations and durations may be greater than accepted toxic thresholds for acute casualty, in the event of a worst case release or maximum credible release scenario during launch or reentry.

Uncontrolled Area - an area of land not controlled by a launch or reentry operator, a launch or reentry site operator, an adjacent site operator, or other entity by agreement.

Unguided Suborbital Launch Vehicle - a suborbital rocket that does not contain active guidance or a directional control system.

Uprange - the distance measured along a line that is 180 degrees to the downrange direction.

Useful Mission - a mission that can attain one or more objectives.

Validation - an evaluation to determine that each safety measure derived from a system safety process is correct, complete, consistent, unambiguous, verifiable, and technically feasible. Validation ensures that the right safety measure is implemented, and that the safety measure is well understood.

Vehicle - a functional part of a vehicle system able to perform a flight in one portion of the intended flight path. An aircraft is a particular type of vehicle.

Vehicle Operator - any legal person which is the holder of a licence, an experimental permit or other authorization under this regulation.

Vehicle System - A system intended to fly in a suborbital flight, air-launching/re-entry operation, or to transit through the Higher Airspace, composed of one or more vehicles, also generally referred to as stages. The stages of a vehicle system may have different types of propulsion systems.

Verification - an evaluation to determine that safety measures derived from a system safety process are effective and have been properly implemented. Verification provides measurable evidence that a safety measure reduces risk to acceptable levels.

Wind Weighting Safety System - equipment, procedures, analysis and personnel functions used to determine the launcher elevation and azimuth settings that correct for wind effects that an unguided suborbital launch vehicle will experience during flight.

Window Closure - a period of time when launch or reentry is not permitted in order to avoid a collision with an object in orbit. A window closure may occur within a launch or reentry window, may delay the start of a window, or terminate a window early.

5 ACRONYMS

A-A	A to A
A-B	A to B
AHA	Aircraft Hazard Area
ACSS	Airborne Control and Support Station
ALARP	As Low As Reasonably Practicable
AMC	Acceptable Means of Compliance
AMSL	Above Mean Sea Level
ANSP	Air Navigation Service Provider
ATC	Air Traffic Control
ATM	Air Traffic Management
ATSP	Air Traffic Service Provider
C2	Command and Control
CC	Control Centre
CST	Commercial Suborbital transportation
ELOS	Equivalent Level Of Safety
ELV	Expendable Launch Vehicles
ENAC	Ente Nazionale per l'Aviazione Civile (Italian Civil Aviation Authority)
FIR	Flight Information Region
FL	Flight Level
FCOA	Foreign Country Operator Authorization
GM	Guidance Material
GSE	Ground Support Equipment
HA	Higher Airspace
HAPS	High Altitude Platform Systems
HTOL	Horizontal Take-off and Landing
HTPB	Hydroxyl-terminated polybutadiene
IIP	Instantaneous Impact Point
ISS	International Space Station
ItAF	Italian Air Force
LEO	Low Earth Orbit
LOX	Liquid Oxygen

MAE	Ministry of Foreign Affairs
MCC	Mission Control Center
MCR	Mission Control Room
MIMS	Ministry of sustainable infrastructures and mobility
MOD	Ministry of Defence
MPC	Mission Payload Control
MPL	Maximum probable loss
MWO	Meteorological Watch Office (ItAF)
NOTAM	Notice to Airmen, Notice to Air Missions
NTM	Notice to Mariners
PBR	Performance Based Requirements / Regulation
PCC	Payload Control Center
RLV	Reusable Launch Vehicle
ROS	Reference Operational Scenario
RPAS	Remotely Piloted Aircraft System
RSV	Suborbital Reusable Vehicle
SASO	Suborbital and Access to Space Operation
SCSS	Ship Control and Support Station
SFP	Spaceflight participant
SSTO	Single Stage To Orbit
SMS	Safety Management System
S/S	Sub System
STM	Space Traffic Management
SV	Suborbital Vehicle
TC	Tele-command
TM	Telemetry
TPL	Third Party Liability
TSTO	Two Stage To Orbit
UAS	Unmanned Aircraft System
VTHOL	Vertical Take-Off and Horizontal Landing
VTOL	Vertical Take-Off Landing
VTVL	Vertical Take-off and Vertical Landing

SECTION II – ADMINISTRATIVE AND FINANCIAL

1 PROCEDURES

1.1 GENERAL INFORMATION

SASO-450.3 Scope of a vehicle system operator licence

(a) [reserved]

(b) Scope of launch. A vehicle system operator licence authorises launch, which includes the flight of a vehicle system and pre- and post-flight ground operations as follows:

(1) Launch begins when hazardous pre-flight ground operations or any hazardous activity preparing the vehicle for flight commence. Hazardous pre-flight operations do not include the period between the end of the previous launch and launch vehicle reuse when the vehicle is in a safe and dormant state.

(2) [reserved]

(3) Launch ends when any of the following events occur:

(i) [reserved];

(ii) [reserved];

(iii) for a suborbital launch, launch ends after the vehicle or vehicle component impact or landing on Earth, after activities necessary to return the vehicle, or vehicle component, to a safe condition on the ground after impact or landing are accomplished or after activities necessary to return the site to a safe condition, whichever occurs later;

(iv) [reserved].

(c) Scope of reentry. [reserved]

(d) Application requirements. An applicant must identify the intended operations in accordance to **SASO-GEN.10** including pre- and post-flight ground operations at a launch site sufficient for ENAC to determine the scope of operations authorised under the licence.

SASO-450.5 Issuance of a vehicle system operator licence

(a) ENAC issues a vehicle system operator licence to an applicant when the applicant has demonstrated compliance with the applicable requirements of this regulation.

(b) A vehicle system operator licence authorises a licensee to conduct launches or re-entries, in accordance with the representations contained in the licensee's

application, with Sections III, IV and V as applicable and Chapter 2 of this part, and subject to the licensee's compliance with terms and conditions contained in licence orders accompanying the licence, including financial responsibility requirements.

SASO-450.7 Duration of a vehicle system operator licence

A vehicle system operator licence is valid for the period of time determined by ENAC as necessary to conduct the licensed activity but may not exceed 5 years from the issuance date.

SASO-450.9 Additional licence terms and conditions

ENAC may modify a vehicle system operator licence at any time by modifying or adding licence terms and conditions to ensure compliance with laws and regulations.

SASO-450.13 Rights not conferred by a vehicle system operator licence

Issuance of a vehicle system operator licence does not relieve a licensee of its obligation to comply with all applicable requirements of law or regulation that may apply to its activities.

1.2 REQUIREMENTS TO OBTAIN A VEHICLE SYSTEM OPERATOR LICENCE

SASO-413.5 Pre-application consultation

A prospective applicant must consult with the ENAC before submitting an application to discuss the application process and possible issues relevant to the ENAC's licensing or permitting decision. Early consultation helps an applicant to identify possible regulatory issues at the planning stage when changes to an application or to proposed licensed or permitted activities are less likely to result in significant delay or costs to the applicant.

SASO-450.31 General

(a) To obtain a vehicle system operator licence, in addition to the other requirements of this regulation, an applicant must

(1) Submit a preliminary licence application in a form and manner established by ENAC;

(2) Obtain a policy approval from ENAC in accordance with **SASO-450.41**;

(3) Obtain the acceptance of the means of compliance in accordance with **SASO-450.35**;

(4) Submit a licence application in a form and manner established by ENAC;

(5) Obtain a favourable payload review determination from ENAC in accordance with **SASO-450.43**, if applicable;

(6) Obtain a safety approval from ENAC in accordance with **SASO-450.45**;

(7) Satisfy the environmental review requirements of **SASO-450.47**; and

(8) Comply with insurance requirements required by **SASO-450.206**.

(b) [reserved].

(c) [reserved].

(d) An applicant may reference materials previously provided as part of a licence application in order to meet the application requirements of this part.

(e) The vehicle system operator shall comply with the relevant requirements contained in Sections III, IV and V of this regulation, as applicable, and with any other relevant law and regulation applicable in Italy.

SASO-450.33 Incremental review and determinations

[reserved]

SASO-450.35 Accepted means of compliance

(a) Prior to application acceptance required by **SASO-450.31(a)(4)**, ENAC accepts the means of compliance regarding:

(1) flight safety analyses methods;

(2) toxic hazard for flight operations;

(3) highly-reliable flight safety system design reliability;

(4) flight commit criteria for lightning hazard mitigation; and

(5) risk assessment for toxic hazards mitigation for ground operations.

(b) The applicant requesting acceptance of a proposed means of compliance outside a licence application must submit the proposed means of compliance to the ENAC in a form and manner acceptable to ENAC.

SASO-450.37 Equivalent level of safety

(a) Ref. **SASO-GEN.20**.

(b) [reserved].

SASO-450.39 Use of approved elements

The applicant may take credit from previously approved elements of the operations including vehicle, safety system, process, service, personnel or any identified component thereof, approved by ENAC or qualified entities by ENAC.

SASO-450.41 Policy review and approval

(a) Prior to application acceptance required by **SASO-450.31(a)(4)**, ENAC issues a policy approval to an applicant in accordance with ENAC procedures, unless ENAC determines that a proposed launch or reentry may jeopardise national security or foreign policy interests, or international obligations of Italy.

(b) [reserved].

(c) [reserved].

(d) [reserved].

(e) [reserved].

SASO-450.43 Payload review and determination

(a) ENAC issues a favourable payload determination for a launch or reentry to a licence applicant or payload owner or operator if:

(1) The applicant has obtained all required licences, authorizations, and permits; and

(2) Its launch or reentry would not jeopardise public health and safety, safety of property, national security or foreign policy interests, or international obligations of Italy.

(b) [reserved].

(c) Classes of payloads. ENAC may review and issue findings regarding a proposed class of payload, including communications, remote sensing, or navigation. However, prior to a launch or reentry, each payload is subject to verification by ENAC that its launch or reentry would not jeopardise public health and safety, safety of property, national security or foreign policy interests, or international obligations of Italy.

(d) [reserved].

(e) Interinstitutional consultation. ENAC may consult with other national institutions as follows:

(1) to determine whether launch or reentry of a proposed payload or payload class would present any issues affecting national security;

(2) to determine whether launch or reentry of a proposed payload or payload class would present any issues affecting foreign policy interests or international obligations of Italy; or

(3) to address issues of public health and safety, safety of property, national security or foreign policy interests, or international obligations of Italy, associated with the launch or reentry of a proposed payload or payload class.

(f) [reserved].

(g) [reserved].

(h) Incorporation of payload determination in licence application. A favourable payload determination issued for a payload or class of payload may be included by a licence applicant as part of its application. Any change in information provided in the payload determination application must be notified to ENAC in order to determine whether a favourable payload determination remains valid in light of reported changes or an additional payload review is needed.

(i) [reserved].

SASO-450.45 Safety review and approval

[reserved]

SASO-450.47 Environmental review

[reserved]

SASO-450.48 Environmental requirements

The vehicle system operator shall comply with the relevant environmental requirements contained in Sections III, IV and V of this regulation, as applicable, and with any other relevant law and regulation applicable in Italy.

2 FINANCIAL, ADMINISTRATIVE AND INSURANCE REQUIREMENTS

2.1 FINANCIAL AND ADMINISTRATIVE REQUIREMENTS

SASO-ADM.5

To obtain and maintain a licence under this regulation a vehicle system operator shall comply with the financial and administrative requirements contained in this paragraph 2.1 of Section II.

SASO-ADM.10

The vehicle system operator shall demonstrate on the basis of its business plan that it is able to ensure the continuing compliance with the applicable requirements of this regulation.

SASO-ADM.15

The vehicle system operator shall be established in Italy and registered to the Italian Chamber of Commerce.

SASO-ADM.20

The vehicle system operator shall have one or more vehicle systems at its disposal through ownership or a lease agreement.

SASO-ADM.25

The vehicle system operator shall comply with the insurance requirements specified in paragraph 2.2 of this Section.

SASO-ADM.30

The vehicle system operator shall comply with the Legislative Decree 6 September 2011 n. 159.

SASO-ADM.35

The persons who continuously and effectively manage the vehicle system operator are of good repute as resulting from an extract from the judicial record or an equivalent document.

2.2 INSURANCE

SASO-INS.5 Licence insurance requirement

(a) In order to obtain a licence in accordance with **SASO-GEN.22(b)** the vehicle system operator must take out a TPL insurance, or an equivalent means accepted by ENAC, to cover the damages to third parties that may occur during the complete operation related to the licence, including the pre-flight and flight phase for an insurance premium determined by a MPL calculation, for a maximum coverage of 60 M€.

(b) The MPL model is defined in accordance with the ENAC guidelines and excluding improbable events with probability of occurrence less than or equal to 1x10-7.

(c) The insurance referred to point (a) must include as additional insured parties the State of Italy, ENAC and the other involved entities in the operation.

SASO-INS.10 Experimental permit insurance

In order to obtain an experimental permit in accordance with **SASO-GEN.22(c)** the vehicle system operator must comply with **SASO-INS.5** excluding the limit of 60M€.

SASO-INS.15 FCOA insurance

In order to obtain a FCOA in accordance with **SASO-GEN.22(d)** the vehicle system operator:

(a) must comply with **SASO-INS.5** limited to the pre-flight phase.

(b) must take out a supplementary insurance policy for the flight phase, if needed, in accordance with the TIP of the bilateral agreement referred in **SASO-GEN.22(d)** and deemed adequate by ENAC in order to comply with **SASO-INS.5(a)**.

SASO-INS.20 Wilful misconduct and gross negligence

In case of wilful misconduct, gross negligence and violation of the conditions and limitations specified in the authorization referred to **SASO-GEN.22**, the vehicle system operator's third party liability must be considered unlimited.

3 TERMS AND CONDITIONS OF A VEHICLE SYSTEM OPERATOR LICENCE

SASO-450.201 Public safety responsibility

An authorised operator is responsible for ensuring public safety and safety of property during the conduct of an authorised operation.

SASO-450.203 Compliance with authorization

An operator must conduct authorised operations in accordance with the requirements of Subparts II and III and the terms and conditions contained in the authorization. An authorised operator's failure to act in accordance with the representations made in the authorization application, the requirements of subparts C and D of this part, and the terms and conditions contained in the authorization, is sufficient basis for the revocation of an authorization or other appropriate enforcement action.

SASO-450.209 Compliance monitoring

(a) An authorised operator must allow access by, and cooperate with, ENAC officers or employees or other individuals authorised by ENAC to observe any of its activities, or of its contractors or subcontractors, associated with the conduct of an authorised launch.

(b) For each licensed launch or reentry, a licensee must provide ENAC with a console for monitoring the progress of the countdown and communication on all channels of the countdown communications network, unless the licensee has another acceptable means. A licensee must also provide ENAC with the capability to communicate with the mission director designated by **SASO-S450.103(a)(1)**.

SASO-450.211 Continuing accuracy of authorization application; Application for modification of authorization

(a) An authorised operator is responsible for the continuing compliance with applicable requirements of this regulation and Terms and Approvals contained in the authorization. After an authorization has been issued, an authorised operator must apply to the competent Authority for modification of the authorization if

(1) The operator proposes to conduct an operation outside the authorization granted, unless otherwise authorised by the competent authority; or

(2) the assumptions on which the authorization is based are no longer valid.

(b) An application to modify an authorization must be prepared and submitted in accordance with Section II of this regulation. If requested during the application process, the competent Authority may approve an alternate method for requesting authorization modifications.

(c) Upon approval of a modification, the competent Authority issues either an amendment of the existing authorization or a new authorization as deemed appropriate in relation to the extent and significance of the modification.

SASO-450.213 Pre-flight reporting

[reserved]

SASO-450.215 Post-flight reporting

[reserved]

SASO-450.217 Registration of space objects

[reserved]

SASO-450.219 Records and access

(a) Except as specified in paragraph (b) of this requirement, an authorised operator must maintain for 5 years all records, data, and other material necessary to verify that a launch is conducted in accordance with representations contained in the authorised operator's application, the requirements of subparts C and D of this part, and the terms and conditions contained in the authorization.

(b) For an event that meets any of paragraph (1) through (5) or paragraph (8) of the definition of ''mishap'', an authorised operator must preserve all records related to the event.

Records must be retained until completion of investigation and the investigating authority advises the licensee that the records need not be retained.

(c) For the purpose of determining compliance with the relevant requirements, the authorised operator shall grant access at any time to any facility, vehicle, document, records, data, procedures or any other material relevant to its activity subject to ENAC authorization, whether it is contracted or not, to any person authorised by ENAC.

4 FEES

SASO-FEE.5

(a) Licence is subjected to payment of fees established by ENAC Fees Regulation - Part IV.

(b) Experimental Permit is subject to payment of fees established by ENAC Fees Regulation - Part II - art. 16.

SECTION III - REQUIREMENTS FOR SUBORBITAL OPERATIONS

1 OPERATIONS LICENCE REQUIREMENTS

1.1 PART S450 –VEHICLE SYSTEM OPERATOR LICENCE REQUIREMENTS FOR PUBLIC SAFETY

1.1.1 PUBLIC SAFETY CRITERIA

SASO-S450.101 Public safety criteria

(a) Launch risk criteria. An operator may initiate the flight of a launch vehicle only if all risks to the public satisfy the criteria below.

The following criteria apply to each launch vehicle flight from liftoff through final impact or landing:

(1) Collective risk. The collective risk, measured as expected number of casualties (Ec), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. The competent authority will determine whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis.

(i) The risk to all members of the public must not exceed an expected number of **2x10-5** casualties.

(ii) [reserved]

(2) Individual risk. The individual risk, measured as probability of casualty (Pc), consists of risk posed by impacting inert and explosive debris, toxic release, and far field blast overpressure. The competent authority will determine whether to approve public risk due to any other hazard associated with the proposed flight of a launch vehicle on a case-by-case basis.

(i) The risk to any individual member of the public must not exceed a probability of casualty of **1×10–6** per launch.

(ii) [reserved]

(3) Aircraft risk. A launch operator must establish any aircraft hazard areas necessary to ensure the probability of impact with debris capable of causing a casualty for aircraft does not exceed **1×10–6**.

(4) Risk to critical assets.

(i) The risk to critical assets, measured as the probability of loss of functionality, must not exceed the following probabilities:

(A) For each critical asset, except for a critical payload, **1×10–3**; and

(B) For each critical payload, **1×10–4**

(ii) ENAC will consult with relevant national administrations, and each administration will identify, for purposes of this requirement, any critical assets that the administration owns or otherwise depends on.

(iii) ENAC will notify the licensee of any risk to critical assets above the risk criteria in paragraph (4)(i) of this paragraph.

(iv) ENAC may determine, in consultation with relevant national administrations, that a more stringent probability is necessary to protect the national interests of Italy.

(v) The risk criteria in paragraph (4)(i) of this requirement do not apply to property, facilities, or infrastructure supporting the launch that are within the prescribed public area distance of the vehicle's launch point.

(b) Reentry risk criteria. [reserved]

(c) Hight Consequence event protection. An operator must protect against a high consequence event in uncontrolled areas for each phase of flight by:

(1) Using flight abort as a hazard control strategy in accordance with the requirements of **SASO-S450.108**;

(2) Ensuring the consequence of any reasonably foreseeable failure mode, in any significant period of flight, is no greater than **1×10-3** conditional expected casualties; or

(3) Establishing the launch vehicle has sufficient demonstrated reliability as agreed to by the competent authority based on conditional expected casualties criteria during that phase of flight.

(d) Disposal safety criteria. [reserved]

(e) Protection of people and property on-orbit. [reserved]

(f) Notification of planned impacts. For any launch an operator must notify the public of any region of land, sea, or air that contain, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty.

(g) Validity of the analysis. For any analysis used to demonstrate compliance with this requirement, an operator must use accurate data and scientific principles and be statistically significant. The method must produce results consistent with or more

conservative than the results available from previous mishaps, tests, or other valid benchmarks, such as higher-fidelity methods.

SASO-S450.102 Public safety criteria extended

[reserved]

1.1.2 SYSTEM SAFETY PROGRAM

SASO-S450.103 System safety program

An operator must implement and document a system safety program throughout the operational life cycle of a launch system that includes the following:

(a) Safety organisation. An operator must maintain and document a safety organisation that has clearly defined lines of communication and approval authority for all public safety decisions. At a minimum, the safety organisation must have the following positions:

(1) Mission director. For each launch, an operator must designate a position responsible for the safe conduct of all licensed activities and authorised to provide final approval to proceed with licensed activities. This position is referred to as the mission director in this regulation.

(2) Safety official. For each launch, an operator must designate a position with direct access to the mission director that is

(i) Responsible for communicating potential safety and noncompliance issues to the mission director; and

(ii) Authorised to examine all aspects of the operator's ground and flight safety operations, and to independently monitor compliance with the operator's safety policies, safety procedures, and licensing requirements.

(3) The mission director must ensure that all of the safety official's concerns are addressed.

(b) Hazard management. For hazard management:

(1) An operator must implement methods to assess the system to ensure the validity of the hazard control strategy determination and any flight hazard or flight safety analysis throughout the lifecycle of the launch system;

(2) An operator must implement methods for communicating and implementing any updates throughout the organisation; and

(3) Additionally, an operator required to conduct a flight hazard analysis must implement a process for tracking hazards, risks, mitigation measures, and verification activities.

(c) Configuration management and control. An operator must

(1) Employ a process that tracks configurations of the suborbital vehicle, including the payload, and of all safety-critical systems, and documentation related to the operation;

(2) Ensure the use of correct and appropriate versions of systems and documentation tracked in paragraph (c)(1) of this requirement; and

(3) Maintain records of launch or system configurations and document versions used for each licensed activity, as required by **SASO-450.219,** identified in paragraph (c)(2).

(d) Post-flight data review. An operator must employ a process for evaluating post-flight data to:

(1) Ensure consistency between the assumptions used for the preliminary safety assessment (hazard control strategy determination), any hazard or flight safety analysis, and associated mitigation and hazard control measures;

(2) Resolve any identified inconsistencies identified in paragraph (d)(1) prior to the next flight of the vehicle;

(3) Identify any anomaly that may impact any flight hazard analysis, flight safety analysis, or safety critical system, or is otherwise material to public health and safety and the safety of property; and

(4) Address any anomaly identified in paragraph (d)(3) of this requirement prior to the next flight, including updates to any flight hazard analysis, flight safety analysis, or safety critical system.

(e) Application requirements. An applicant must submit in its application the following:

(1) A description of the applicant's safety organisation as required by paragraph (a) of this requirement, identifying the applicant's lines of communication and approval authority, both internally and externally, for all public safety decisions and the provision of public safety services; and

(2) A summary of the processes and products identified in the system safety program requirements in paragraphs (b), (c), and (d) of this requirement.

1.1.3 HAZARD CONTROL STRATEGIES

SASO-S450.105 Preliminary safety assessment for flight

[reserved]

SASO-S450.107 Hazard control strategies

(a) General. To meet the safety criteria of **SASO-S450.101(a)**, **(b)**, or **(c)** for the flight, or any phase of flight, of a launch vehicle, an operator must use one or more of the hazard control strategies identified in **SASO-S450.108** through **SASO-S450.111**.

(b) Hazard control strategy determination. For each phase of flight during a launch, an operator must use a functional hazard analysis to determine a hazard control strategy or strategies that account for

(1) all functional failures associated with reasonably foreseeable hazardous events that have the capability to create a hazard to the public;

(2) safety critical systems; and

(3) a timeline of all safety-critical events.

(c) Flight hazard analysis. An operator must conduct a flight hazard analysis in accordance with **SASO-S450.109** of this regulation for the flight, or phase of flight, of a launch vehicle if the public safety hazards cannot be mitigated adequately to meet the public risk criteria of **SASO-S450.101(a)**, **(b)**, and **(c)** using physical containment, wind weighting, or flight abort.

(d) Application requirements. An applicant must submit in its application

(1) The results of the hazard control strategy determination, including

(i) All functional failures identified under paragraph (b)(1) of this requirement;

(ii) The identification of all safety-critical systems; and

(iii) A timeline of all safety-critical events.

(2) A description of its hazard control strategy or strategies for each phase of flight.

SASO-S450.108 Flight abort

(a) Applicability. This requirement applies to the use of flight abort as a hazard control strategy for the flight, or phase of flight, of a launch vehicle to meet the safety criteria of **SASO-S450.101**.

(b) Flight safety system. An operator must use a flight safety system that:

(1) meets the requirements of **SASO-S450.145** if the consequence of any reasonably foreseeable failure mode in any significant period of flight is greater than **1×10–2** conditional expected casualties in uncontrolled areas; or

(2) meets the requirements of **SASO-S450.143** if the consequence of any reasonably foreseeable failure mode in any significant period of flight is between **1×10–2** and **1×10–3** conditional expected casualties for uncontrolled areas.

(c) Flight safety limits objectives. An operator must determine and use flight safety limits that define when an operator must initiate flight abort for each of the following

(1) to ensure compliance with the safety criteria of **SASO-S450.101(a)** and **(b)**;

(2) to prevent continued flight from increasing risk in uncontrolled areas if the vehicle is unable to achieve a useful mission;

(3) to prevent the vehicle from entering a period of materially increased public exposure in uncontrolled areas, if a critical vehicle parameter is outside its pre-established expected range or indicates an inability to complete flight within the limits of a useful mission;

(4) to prevent conditional expected casualties greater than **1×10–2** in uncontrolled areas due to flight abort or due to flight outside the limits of a useful mission from any reasonably foreseeable off-trajectory failure mode in any significant period of flight; and

(5) to prevent the vehicle state from reaching identified conditions that are anticipated to compromise the capability of the flight safety system if further flight has the potential to violate a flight safety limit.

(6) in lieu of paragraphs (c)(2) and (4) of this requirement, to prevent debris capable of causing a casualty due to any hazard from affecting uncontrolled areas using a flight safety system that complies with **SASO-S450.145**.

(d) Flight safety limits constraints. An operator must determine flight safety limits that:

(1) Account for temporal and geometric extents on the Earth's surface of any reasonably foreseeable vehicle hazards under all reasonably foreseeable conditions during normal and malfunctioning flight;

(2) Account for physics of hazard generation and transport including uncertainty;

(3) Account for the potential to lose valid data necessary to evaluate the flight abort rules;

(4) Account for the time delay, including uncertainties, between the violation of a flight abort rule and the time when the flight safety system is expected to activate;

(5) Account in individual, collective, and conditional risk evaluations both for proper functioning of the flight safety system and failure of the flight safety system;

(6) Are designed to avoid flight abort that results in increased collective risk to the public in uncontrolled areas, compared to continued flight; and

(7) Ensure that any trajectory within the limits of a useful mission that is permitted to fly without abort would meet the collective risk criteria of **SASO-S450.101(a)(1)** when analysed as if it was the planned mission in accordance with **SASO-450.213**.

(e) End of flight abort. A flight does not need to be aborted to protect against high consequence events in uncontrolled areas beginning immediately after critical vehicle parameters are validated, if the vehicle is able to achieve a useful mission and the following conditions are met for the remainder of flight:

(1) Flight abort would not materially decrease the risk from a high consequence event; and

(2) There are no key flight safety events.

(f) Flight abort rules. For each launch, an operator must establish and observe flight abort rules that govern the conduct of the launch as follows.

(1) Vehicle data required to evaluate flight abort rules must be available to the flight safety system under all reasonably foreseeable conditions during normal and malfunctioning flight.

(2) The flight safety system must abort flight:

(i) When valid, real-time data indicate the vehicle has violated any flight safety limit developed in accordance with this requirement;

(ii) When the vehicle state approaches identified conditions that are anticipated to compromise the capability of the flight safety system and further flight has the potential to violate a flight safety limit; and

(iii) In accordance with methods used to satisfy (d)(3) of this requirement, if tracking data is invalid and further flight has the potential to violate a flight safety limit.

(g) Application requirements. An applicant must submit in its application the following:

(1) a description of the methods used to demonstrate compliance with paragraph (c) of this requirement, including descriptions of how each analysis constraint in paragraph (d) of this requirement is satisfied in accordance with **SASO-S450.115**.

(2) a description of how each flight safety limit and flight abort rule is evaluated and implemented during vehicle flight, including the quantitative criteria that will be used, a description of any critical parameters, and how the values required in paragraphs (c)(3) and (e) of this requirement are identified;

(3) a graphic depiction or series of depictions of flight safety limits for a representative mission together with the launch or landing point, all uncontrolled area boundaries, the nominal trajectory, extents of normal flight, and limits of a useful mission trajectories, with all trajectories in the same projection as each of the flight safety limits; and

(4) a description of the vehicle data that will be available to evaluate flight abort rules under all reasonably foreseeable conditions during normal and malfunctioning flight.

SASO-S450.109 Flight hazard analysis

(a) Applicability. This requirement applies to the use of a flight hazard analysis as a hazard control strategy to derive hazard controls for the flight, or phase of flight, of a launch vehicle. Hazards associated with computing systems and software are further addressed in **SASO-S450.141**.

(b) Analysis. A flight hazard analysis must identify, describe, and analyze all reasonably foreseeable hazards to public safety and safety of property resulting from the flight of a launch vehicle. Each flight hazard analysis must

(1) Identify all reasonably foreseeable hazards, and the corresponding vehicle response mode for each hazard, associated with the launch system relevant to public safety and safety of property, including those resulting from:

(i) Vehicle operation, including staging and release

(ii) System, subsystem, and component failures or faults

(iii) Software operations

(iv) Environmental conditions

(v) Human factors

(vi) Design inadequacies

(vii) Procedure deficiencies

(viii) Functional and physical interfaces between subsystems, including any vehicle payload

(ix) Reuse of components or systems; and

(x) Interactions of any of the above.

(2) Assess each hazard's likelihood and severity;

(3) Ensure that the likelihood of any hazardous condition that may cause death or serious injury to the public is extremely remote.

(4) Identify and describe the risk elimination and mitigation measures required to satisfy paragraph (b)(3) of this requirement.

(5) Demonstrate that the risk elimination and mitigation measures achieve the risk levels of paragraph (b)(3) of this requirement through validation and verification. Verification includes:

(i) Analysis;

(ii) Test;

(iii) Demonstration; or

(iv) Inspection.

(c) New hazards. An operator must establish and document the criteria and techniques for identifying new hazards throughout the lifecycle of the launch system.

(d) Completeness Prior to Flight. For every launch, the flight hazard analysis must be complete and all hazards must be mitigated to an acceptable level in accordance with paragraph (b)(3) of this requirement.

(e) Updates. An operator must continually update the flight hazard analysis throughout the operational life cycle of the launch system.

(f) Application requirements. An applicant must submit in its application the following:

(1) Flight hazard analysis products of paragraphs (b)(1) through (5) of this requirement, including data that verifies the risk elimination and mitigation measures resulting from the applicant's flight hazard analyses required by paragraph (b)(5) of this requirement; and

(2) The criteria and techniques for identifying new hazards throughout the lifecycle of the launch system as required by paragraph (c) of this requirement.

SASO-S450.110 Physical containment

(a) Applicability. This requirement applies to the use of physical containment as a hazard control strategy for the flight, or phase of flight, of a launch vehicle to meet the safety criteria of **SASO-S450.101(a), (b)**, and **(c)**.

(b) Containment. To use physical containment as a hazard control strategy, an operator must

(1) Develop the flight hazard area in accordance with **SASO-S450.133**;

(2) Ensure that the launch vehicle does not have sufficient energy for any hazards associated with its flight to reach outside the flight hazard area;

(3) Ensure the hazard area is clear of the public and critical assets; and

(4) Apply other mitigation measures necessary to ensure no public or critical asset exposure to hazards, such as control of public access or wind placards.

(c) Application requirements. An applicant must submit in its application the following:

(1) A demonstration that the launch vehicle does not have sufficient energy for any hazards associated with its flight to reach outside the flight hazard area developed in accordance with **SASO-S450.133**; and

(2) A description of the methods used to ensure that flight hazard areas are cleared of the public and critical assets.

SASO-S450.111 Wind weighting

(a) Applicability. This requirement applies to the use of wind weighting as a hazard control strategy for the flight of an unguided suborbital launch vehicle to meet the safety criteria of **SASO-S450.101(a), (b)**, and **(c)**.

(b) Wind weighting safety system. The flight of an unguided suborbital launch vehicle that uses a wind weighting safety system must meet the following:

(1) The launcher azimuth and elevation settings must be wind weighted to correct for the effects of wind conditions at the time of flight to provide impact locations that will ensure compliance with the safety criteria in **SASO-S450.101**; and

(2) An operator must use launcher azimuth and elevation angle settings that ensures the rocket will not fly in an unintended direction accounting for uncertainties in vehicle and launcher design and manufacturing, and atmospheric uncertainties.

(c) Analysis. An operator must:

(1) Establish flight commit criteria and other flight safety rules that control the risk to the public from potential adverse effects resulting from normal and malfunctioning flight;

(2) Establish any wind constraints under which flight may occur; and

(3) Conduct a wind weighting analysis that establishes the launcher azimuth and elevation settings that correct for the windcocking and wind-drift effects on the unguided suborbital launch vehicle.

(d) Stability. An unguided suborbital launch vehicle, in all configurations, must be stable throughout each stage of powered flight.

(e) Application requirements. An applicant must submit in its application the following:

(1) A description of its wind weighting analysis methods, including its method and schedule of determining wind speed and wind direction for each altitude layer;

(2) A description of its wind weighting safety system including all equipment used to perform the wind weighting analysis; and

(3) A representative wind weighting analysis using actual or statistical winds for the launch area and samples of the output.

1.1.4 FLIGHT SAFETY ANALYSES

SASO-S450.113 Flight safety analysis requirements - Scope and applicability

(a) Scope. An operator must perform and document a flight safety analysis for all phases of flight, except as specified in paragraph (b) of this requirement, as follows:

(1) [reserved];

(2) For suborbital launch, from liftoff through landing or final impact;

(3) [reserved];

(4) [reserved].

(b) An operator is not required to perform and document a flight safety analysis for a phase of flight if agreed to by the competent authority based on demonstrated reliability. An operator demonstrates reliability by using operational and flight history to show compliance with the risk criteria in **SASO-S450.101(a)** and **(b)**.

SASO-S450.115 Flight safety analysis methods

(a) Scope of the analysis. An operator's flight safety analysis method must account for all reasonably foreseeable events and failures of safety-critical systems during nominal and non-nominal launch that could jeopardize public safety.

(b) Level of fidelity of the analysis. An operator's flight safety analysis method must have a level of fidelity sufficient to:

(1) Demonstrate that any risk to the public satisfies the public safety criteria of **SASO-S450.101**, including the use of mitigations, accounting for all known sources of uncertainty, using a means of compliance accepted by the competent authority; and

(2) Identify the dominant source of each type of public risk with a criterion in **SASO-S450.101(a)** in terms of phase of flight, source of hazard (such as toxic exposure, inert, or explosive debris), and vehicle response mode.

(c) Application requirements. An applicant must submit a description of the flight safety analysis methodology, including identification of:

(1) The scientific principles and statistical methods used;

(2) All assumptions and their justifications;

(3) The rationale for the level of fidelity;

(4) The evidence for validation and verification required by **SASO-S450.101(g)**;

(5) The extent that the benchmark conditions are comparable to the foreseeable conditions of the intended operations; and

(6) The extent that risk mitigations were accounted for in the analyses.

SASO-S450.117 Trajectory analysis for normal flight

(a) General. A flight safety analysis must include a trajectory analysis that establishes, for any phase of flight within the scope as provided by **SASO-S450.113(a)**, the limits of a launch vehicle's normal flight as defined by the nominal trajectory, and the following sets of trajectories sufficient to characterise variability and uncertainty during normal flight:

(1) A set of trajectories to characterise variability. This set must describe how the intended trajectory could vary due to conditions known prior to initiation of flight; and

(2) A set of trajectories to characterise uncertainty. This set must describe how the actual trajectory could differ from the intended trajectory due to random

uncertainties in all parameters with a significant influence on the vehicle's behaviour throughout normal flight.

(b) Trajectory model. A final trajectory analysis must use a six-degree of freedom trajectory model to satisfy the requirements of paragraph (a) of this requirement.

(c) Atmospheric effects. A trajectory analysis must account for atmospheric conditions that have an effect on the trajectory, all wind effects, including profiles of winds that are no less severe than the worst wind conditions under which flight might be attempted, and for uncertainty in the atmospheric conditions.

(d) [reserved].

SASO-S450.119 Trajectory analysis for malfunction or failure in flight

(a) General. A flight safety analysis must include a trajectory analysis that establishes:

(1) The vehicle's deviation capability in the event of a malfunction or a failure during flight,

(2) The trajectory dispersion resulting from reasonably foreseeable malfunctions or failures, and

(3) For vehicles using flight abort as a hazard control strategy under **SASO-S450.108**, trajectory data or parameters that describe the limits of a useful mission. The collection of data related to a failure is not considered a useful mission.

(b) Analysis constraints. A malfunction trajectory analysis must account for each cause of a malfunction flight, including software and hardware failures, for every period of normal flight. The analysis for each type of malfunction must have sufficient temporal and spatial resolution to establish flight safety limits, if any, and individual risk contours that are smooth and continuous.

The analysis must account for:

(1) The relative probability of occurrence of each malfunction or failure;

(2) The probability distribution of position and velocity of the vehicle when each malfunction trajectory will terminate due to vehicle breakup or ground impact along with the cause of termination and the state of the vehicle;

(3) The parameters with a significant influence on a vehicle's flight behaviour from the time a malfunction begins to cause a flight deviation until the time each malfunction trajectory will terminate due to vehicle breakup, ground impact; and

(4) The potential for failure of the flight safety system, if any.

(c) [reserved].

SASO-S450.121 Debris analysis

(a) General. A flight safety analysis must include an analysis characterising the hazardous debris generated from normal and malfunctioning vehicle flight as a function of vehicle flight sequence.

(b) Vehicle impact or breakup analysis. A debris analysis must account for:

(1) Each reasonably foreseeable cause of vehicle breakup and intact impact,

(2) Vehicle structural characteristics and materials, and

(3) Energetic effects during break-up or at impact.

(c) Propagation of debris. A debris analysis must compute statistically valid debris impact probability distributions. The propagation of debris from each predicted breakup location to impact must account for:

(4) All foreseeable forces that can influence any debris impact location; and

(5) All foreseeable sources of impact dispersion, including, at a minimum:

(i) The uncertainties in atmospheric conditions;

(ii) Debris aerodynamic parameters, including uncertainties;

(iii) Pre-breakup position and velocity, including uncertainties; and

(iv) Breakup-imparted velocities, including uncertainties.

(d) [reserved].

SASO-S450.123 Population exposure analysis

(a) General. A flight safety analysis must account for the distribution of people for the entire region where there is a significant probability of impact of hazardous debris.

(b) Constraints. The exposure analysis must:

(1) Characterise the distribution of people both geographically and temporally;

(2) Account for the distribution of people among structures and vehicle types;

(3) Use reliable, accurate, and timely source data; and

(4) Account for the vulnerability of people to hazardous debris effects.

(c) [reserved].

SASO-S450.125 Gate analysis

[reserved]

SASO-S450.127 Data Loss Flight Time and Planned Safe Flight State analysis

[reserved]

SASO-S450.129 Time delay analysis

[reserved]

SASO-S450.131 Probability analysis of vehicle failure

(a) General. For each hazard and phase of flight, a flight safety analysis for a launch must account for vehicle failure probability. The probability of failure must be consistent for all hazards and phases of flight.

(1) For a vehicle or vehicle stage with fewer than two flights, the failure probability estimate must account for the outcome of all previous flights of vehicles developed and launched in similar circumstances.

(2) For a vehicle or vehicle stage with two or more flights, vehicle failure probability estimates must account for the outcomes of all previous flights of the vehicle or vehicle stage in a statistically acceptable manner.

(b) Vehicle failure. For flight safety analysis purposes, a failure occurs when a vehicle does not complete any phase of normal flight or when any anomalous condition exhibits the potential for a stage or its debris to impact the Earth or for the exiting of the vehicle or its debris from the allocated airspace volume during the mission or any future mission of similar vehicle capability.

(c) Previous flight. For flight safety analysis purposes

(1) The flight of a launch vehicle begins at a time in which a launch vehicle lifts off from the surface of the Earth;

(2) [reserved].

(d) Allocation. The vehicle failure probability estimate must be distributed across flight phases and failure modes. The distribution must be consistent with:

(1) The data available from all previous flights of vehicles developed and launched in similar circumstances; and

(2) Data from previous flights of vehicles, stages, or components developed and launched flown, or tested by the subject vehicle developer or operator. Such data may include previous experience involving similar:

(i) Vehicle, stage, or component design characteristics;

(ii) Development and integration processes, including the extent of integrated system testing; and

(iii) Level of experience of the vehicle operation and development team members.

(e) Observed vs. conditional failure rate. Probability of failure allocation must account for significant differences in the observed failure rate and the conditional failure rate. A probability of failure analysis must use a constant conditional failure rate for each phase of flight, unless there is clear and convincing evidence of a different conditional failure rate for a particular vehicle, stage, or phase of flight.

(f) [reserved].

SASO-S450.133 Flight hazard area analysis

(a) General. A flight safety analysis must include a flight hazard area analysis that identifies any region of land, sea, or air that must be surveyed, publicised, controlled, or evacuated in order to control the risk to the public. The analysis must account for, at a minimum:

(1) The regions of land, sea, and air potentially exposed to debris impact resulting from normal flight events and from debris hazards resulting from any potential malfunction;

(2) Any hazard controls implemented to control risk;

(3) The limits of a launch vehicle's normal flight, including:

(i) Atmospheric conditions that are no less severe than the worst atmospheric conditions under which flight might be attempted; and

(ii) Uncertainty in the atmospheric conditions;

(4) All hazardous debris;

(5) Sources of debris dispersion in accordance with **SASO-S450.121(c)**; and

(6) A probability of one for any planned debris hazards or planned impacts.

(b) Waterborne vessel hazard areas. The flight hazard area analysis for waterborne vessels must determine the areas and durations for regions of water:

(1) That are necessary to contain, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty to persons on waterborne vessels;

(2) That are necessary to contain either where the probability of debris capable of causing a casualty impacting on or near a vessel would exceed 1x10-5 , accounting for all relevant hazards, or where the individual probability of casualty for any person on-board a vessel would exceed the criterion in **SASO-S450.101(a)(2)** ; and

(3) Where reduced vessel traffic is necessary to meet collective risk criterion in **SASO-S450.101(a)(1)**.

(c) Land hazard areas. The flight hazard area analysis for land must determine the durations and areas regions of land:

(1) That are necessary to contain, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty to any person on land;

(2) Where the individual probability of casualty for any person on land would exceed the criterion in **SASO-S450.101(a)(2)**; and

(3) Where a reduced population is necessary to meet the collective risk criterion in **SASO-S450.101(a)(1)**.

(d) Airspace hazard volumes. The flight hazard area analysis for airspace must determine the durations and volumes for regions of air to be submitted to the competent authority for approval:

(1) That are necessary to contain, with 97 percent probability of containment, all debris resulting from normal flight events capable of causing a casualty to persons on an aircraft; and

(2) Where the probability of impact on an aircraft would exceed the criterion in **SASO-S450.101(a)(3)**.

(e) [reserved]

SASO-S450.135 Debris risk analysis

(a) General: A flight safety analysis must include a debris risk analysis that demonstrates compliance with safety criteria in **SASO-S450.101**, either

(1) Prior to the day of the operation, accounting for all foreseeable conditions within the flight commit criteria; or

(2) During the countdown using the best available input data, including flight commit criteria and flight abort rules.

(b) Casualty area and consequence analysis. A debris risk analysis must model the casualty area, and compute the predicted consequences of each reasonably foreseeable failure mode in any significant period of flight in terms of conditional expected casualties. The casualty area and consequence analysis must account for:

(1) All relevant debris fragment characteristics and the characteristics of a representative person exposed to any potential debris hazard;

(2) Statistically-valid debris impact probability distributions;

(3) Any impact or effects of hazardous debris; and

(4) The vulnerability of people and critical assets to debris impact or effects, including:

(i) Effects of buildings, ground vehicles, waterborne vessel, and aircraft upon the vulnerability of any occupants;

(ii) Effect of atmospheric conditions on debris impact and effects;

(iii) Impact speed and angle, accounting for motion of impacted vehicles;

(iv) Uncertainty in input data, such as fragment impact parameters; and

(v) Uncertainty in modelling methodology.

(c) [reserved].

(d) [reserved].

(e) [reserved].

SASO-S450.137 Far-field overpressure blast effects analysis

(a) General: A light safety analysis must include a far-field overpressure blast effect analysis that demonstrates compliance with safety criteria in **SASO-S450.101**, either

(1) Prior to the day of the operation, accounting for all foreseeable conditions within the flight commit criteria; or

(2) During the countdown using the best available input data, including flight commit criteria and flight abort rules

(b) Analysis constraints. The analysis must account for:

(1) The explosive capability of the vehicle and hazardous debris at impact and at altitude;

(2) The potential influence of meteorological conditions and terrain characteristics; and

(3) The potential for broken windows due to peak incident overpressures below 1.0 psi and related casualties based on the characteristics of exposed windows and the population's susceptibility to injury, with considerations including, at a minimum, shelter types, window types, and the time of day of the proposed operation.

(c) [reserved]

SASO-S450.139 Toxic hazards for flight

(a) Applicability.

(1) Except as specified in (a)(2), this requirement applies to any launch vehicle, including all vehicle components and payloads, that use toxic propellants or other toxic chemicals.

(2) No toxic release hazard analysis is required for kerosene-based fuels, unless the competent authority determines that an analysis is required to protect public safety.

(b) General. An operator must:

(1) Conduct a toxic release hazard analysis in accordance with paragraph (c) of this requirement;

(2) Manage the risk of casualties that could arise from the exposure to toxic release through one of the following means:

(i) Contain hazards caused by toxic release in accordance with paragraph (d) of this requirement; or

(ii) Perform a toxic risk assessment, in accordance with paragraph (e) of this requirement, that protects the public in compliance with the risk criteria of **SASO-S450.101**, including toxic release hazards.

(3) Establish flight commit criteria based on the results of its toxic release hazard analysis, containment analysis, or toxic risk assessment for any necessary evacuation of the public from any toxic hazard area.

(c) Toxic release hazard analysis. A toxic release hazard analysis must

(1) Account for any toxic release that could occur during nominal or non-nominal flight;

(2) Include a worst-case release scenario analysis or a maximum-credible release scenario analysis;

(3) Determine if toxic release can occur based on an evaluation of the chemical compositions and quantities of propellants, other chemicals, vehicle materials, and projected combustion products, and the possible toxic release scenarios;

(4) Account for both normal combustion products and any unreacted propellants and phase change or chemical derivatives of released substances; and

(5) Account for any operational constraints and emergency procedures that provide protection from toxic release.

(d) Toxic containment. An operator using toxic containment must manage the risk of any casualty from the exposure to toxic release either by:

(1) Evacuating, or being prepared to evacuate, the public from a toxic hazard area in the event of a worst-case release or maximum credible release scenario; or

(2) Employing meteorological constraints to limit a launch operation to times during which prevailing winds and other conditions ensure that any member of the public would not be exposed to toxic concentrations and durations greater than accepted toxic thresholds for acute casualty in the event of a worst-case release or maximum-credible release scenario.

(e) Toxic risk assessment. An operator using toxic risk assessment must establish flight commit criteria that demonstrate compliance with the public risk criterion of **SASO-S450.101**. A toxic risk assessment must:

(1) Account for airborne concentration and duration thresholds of toxic propellants or other chemicals. For any toxic propellant, other chemicals, or combustion product, an operator must use airborne toxic concentration and duration thresholds identified in a means of compliance accepted by the competent authority;

(2) Account for physical phenomena expected to influence any toxic concentration and duration in the area surrounding the potential release site;

(3) Determine a toxic hazard area for the launch, surrounding the potential release site for each toxic propellant or other chemical based on the amount and toxicity of the propellant or other chemical, the exposure duration, and the meteorological conditions involved;

(4) Account for all members of the public that may be exposed to the toxic release, including all members of the public on land and on any waterborne vessels, populated offshore structures, and aircraft that are not operated in direct support of the launch; and

(5) Account for any risk mitigation measures applied in the risk assessment.

(f) [reserved].

1.1.5 PRESCRIBED HAZARD CONTROL FOR SAFETY-CRITICAL HARDWARE AND COMPUTING SYSTEMS

SASO-S450.141 Computing systems

(a) Identification of computing system safety items. An operator must identify:

(1) Any software or data that implements a capability that, by intended operation, unintended operation, or non-operation, can present a hazard to the public; and

(2) The level of criticality of each computing system safety item identified in paragraph (a)(1) of this requirement, commensurate with its degree of control over hazards to the public and the severity of those hazards.

(b) Safety requirements. An operator must develop safety requirements for each computing system safety item. In doing so, the operator must:

(1) Identify and evaluate safety requirements for each computing system safety item;

(2) Ensure the safety requirements are complete and correct;

(3) Implement each safety requirement; and

(4) Verify and validate the implementation of each safety requirement by using a method appropriate for the level of criticality of the computing system safety item. For each computing system safety item that is safety critical, verification and validation must include testing by a test team independent of the development division or organisation.

(c) Development process. An operator must implement and document a development process for computing system safety items appropriate for the level of criticality of the computing system safety item. A development process must define:

(1) Responsibilities for each task associated with a computing system safety item;

(2) Processes for internal review and approval including review that evaluates the implementation of all safety requirements such that no person approves that person's own work;

(3) Processes to ensure development personnel are trained, qualified, and capable of performing their role;

(4) Processes that trace requirements to verification and validation evidence;

(5) Processes for configuration management that specify the content of each released version of a computing system safety item;

(6) Processes for testing that verify and validate all safety requirements to the extent required by paragraph (b)(4) of this requirement;

(7) Reuse policies that verify and validate the safety requirements for reused computing system safety items; and

(8) Third-party product use policies that verify and validate the safety requirements for any third-party product.

(d) [reserved]

SASO-S450.143 Safety-critical system design, test, and documentation

(a) Applicability. This requirement applies to all safety-critical systems, except for:

(1) Highly reliable flight safety systems covered under **SASO-S450.145**; or

(2) Safety-critical systems for which an operator demonstrates through its flight hazard analysis that the likelihood of any hazardous condition specifically associated with the system that may cause death or serious injury to the public is extremely remote, pursuant to **SASO-S450.109(b)(3)**.

(b) Design. An operator must design safety-critical systems such that no credible fault can led to increased risk to the public beyond nominal safety-critical system operation.

(c) Qualification testing of design. An operator must functionally demonstrate the design of the vehicle's safety-critical systems at conditions beyond its predicted operation environments. The operator must select environmental test levels that ensure the design is sufficiently stressed to demonstrate that system performance is not degraded due to design tolerances, manufacturing variances, or uncertainties in the environment.

(d) Acceptance of hardware. An operator must:

(1) Functionally demonstrate any safety-critical system while exposed to its operating environment under any foreseeable operating condition with margin to demonstrate that it is free of defects, free of integration and workmanship errors, and ready for operational use; or

(2) Combine in-process controls and a quality assurance process to ensure functional capability of any safety-critical system during its service life.

(e) Lifecycle of safety-critical systems.

(1) The predicted operating environments must be based on conditions predicted to be encountered in all phases of flight, recovery, and transportation.

(2) An operator must monitor the flight environments experienced by safety-critical system components to the extent necessary to:

(i) Validate the predicted operating environments; and

(ii) Assess the actual component life remaining or adjust ant inspection period.

(f) [reserved].

SASO-S450.145 Highly-reliable flight safety system

(a) General. For each phase of flight for which an operator must implement flight abort to meet the requirement of **SASO-S450.108(b)(1)**, the operator must use a highly reliable flight safety system on the launch vehicle, vehicle component, or payload with a design reliability in accordance with this requirement.

(b) Reliability. A highly reliable flight safety system must, using a means of compliance accepted by the competent authority:

(1) Have a design reliability of 0.999 at 95 percent confidence and commensurate design, analysis, and testing for the portion of the flight safety system on-board the vehicle; and

(2) Have a design reliability of 0.999 at 95 percent confidence and commensurate design, analysis, and testing for the portion of the flight safety system not on-board the vehicle, if used.

(c) Monitoring. An operator must monitor the flight environments experienced by any flight safety system component to the extent necessary to:

(1) Validate the predicted operating environment; and

(2) Assess the actual component life remaining or adjust any inspection period.

(d) [reserved].

1.1.6 OTHER PRESCRIBED HAZARD CONTROLS

SASO-S450.147 Agreements

(a) General. An operator must coordinate or establish a written agreement with any entity that provides a service or property that meets a requirement in this regulation, including:

(1) Launch site use agreements. A launch site operator, or any other person that provides services or access to or use of property required to support the safe launch under this regulation;

(2) Coordination with maritime authority. In case of overflight of navigable water, whether a Notice to Marines or other measures to protect public health and safety are necessary to mitigate the risks of the operations, a coordination with the Maritime Authority shall be established.

(3) Coordination for safe access to and use of airspace. Unless otherwise addressed in agreements with the site operator, ENAC, other applicable air navigation authorities and, if necessary, other entities that provide a relevant service, to establish procedures and working methods for the safe access to and use of the airspace (e.g. issuance of the necessary aeronautical information publications or Notice to Airmen prior to a launch, for closing of air routes during the respective launch windows, and for other measures necessary to protect public health and safety); and

(4) Mishap response. Emergency response providers, including local government authorities, to satisfy the requirements of **SASO-S450.173**.

(b) Roles and responsibilities. The agreements required in this requirement must clearly delineate the roles and responsibilities of each party to support the safe launch under this regulation.

(c) Effective date. The agreements required in this requirement must be in effect before a licence can be issued, unless otherwise agreed to by the competent authority.

(d) [reserved].

(e) An operator must provide a copy of any agreement, or portion thereof, to ENAC upon request.

SASO-S450.149 Safety-critical personnel qualifications

(a) An operator must ensure safety-critical personnel is trained, qualified, and capable of performing their safety-critical tasks, and that their training is current.

(b) [reserved].

SASO-S450.150 Safety-critical training requirements and standards

(a) An operator shall establish and maintain training requirements, completion standards, and any currency requirements for flight crew, ground controllers, and safety-critical ground operations personnel.

(b) Safety-Critical Training:

(1) An operator shall ensure that all flight crew, ground controllers, and safety-critical ground operations personnel are trained and qualified to perform their safety-critical functions.

(2) An operator shall retain completed safety-critical training and qualification records.

(c) Instructor Qualification for Safety-Critical Training. An operator should ensure that personnel conducting safety-critical training are qualified in the subject matter and qualified to teach.

SASO-S450.151 Work shift and rest requirements

(a) For any launch, an operator must document and implement rest requirements that ensure safety-critical personnel are physically and mentally capable of performing all assigned tasks.

(b) An operator's rest requirements must address the following:

(1) Duration of each work shift and the process for extending this shift, including the maximum allowable length of any extension;

(2) Number of consecutive work shift days allowed before rest is required;

(3) Minimum rest period required:

(i) Between each work shift, including the period of rest required immediately before the flight countdown work shift; and

(ii) After the maximum number of work shift days allowed; and

(4) Approval process for any deviation from the rest requirements.

(c) [reserved].

SASO-S450.153 Radio frequency management

(a) For any radio frequency used, an operator must:

(1) Ensure radio frequency interference does not adversely affect performance of any flight safety system or safety-critical system; and

(2) Coordinate use of radio frequencies with any site operator and any competent authority.

(b) [reserved].

SASO-S450.155 Readiness

(a) General. An operator must define, document and implement procedures to assess readiness to proceed with the flight of a launch vehicle. These procedures must address, at minimum, the following:

(1) Readiness of vehicle and launch or landing site, including any contingency abort location;

(2) Readiness of safety-critical personnel, systems, software, procedures, equipment, property, and services; and

(3) Readiness to implement the mishap plan required by **SASO-S450.173**.

(b) [reserved].

SASO-S450.157 Communications

(a) An operator must define, document and implement communication procedures during the countdown and flight of a launch vehicle that:

(1) Define the authority of personnel, by individual or position title, to issue "hold/resume," "go/no go," abort commands, and other safety critical decisions during pre-flight and flight;

(2) Assign communication networks so that personnel identified in paragraph (a)(1) of this requirement have direct access to real-time safety-critical information required to issue "hold/resume", "go/no go", and any abort commands;

(3) Implement a protocol for using defined radio telephone (or other means) communications terminology.

(b) An operator must ensure the currency of the communication procedures, and that all personnel are working with the approved version of the communication procedures.

(c) An operator must record all safety-critical communications network channels that are used for voice, video, or data transmissions that support safety critical systems during each countdown.

SASO-S450.159 Pre-flight procedures

(a) An operator must define, document and implement pre-flight procedures that:

(1) Verify that each flight commit criterion is satisfied before flight is initiated; and

(2) Ensure the operator can return the vehicle to a safe state after a countdown abort or delay.

(b) An operator must ensure the currency of the pre-flight procedures, and that all personnel are working with the approved version of the pre-flight procedures.

(c) Prior to any flight, an operator must assess and document that the system is ready to execute the flight within the design and operational limitations of the system.

SASO-S450.161 Surveillance and publication of hazard areas

(a) General. The operator must publicise, survey, control, or evaluate each flight hazard area identified in accordance with flight hazard area analysis requirements (**SASO-S450.133**) prior to initiating flight of a launch vehicle to the extent necessary to ensure compliance with safety criteria in **SASO-S450.101** (safety criteria).

(b) Verification. The launch operator must perform surveillance sufficient to verify or updatethe assumptions, input data, and results of the flight safety analyses.

(c) Publication. An operator must publicise warnings for each flight hazard area, except for regions of land, sea, or air under the control of the vehicle system operator, site operator, or other controlling authority with which the operator has an agreement. If the operator relies on another entity to publicise these warnings, it must:

(1) Determine whether the warnings have been issued; and

(2) Notify the ENAC and the ANSP if the warnings have not been issued so that ENAC can determine if the launch can be conducted in a manner that sufficiently protects the public. This notification must provide sufficient information to enable the ANSP to issue warnings to aircraft.

(d) Application requirements. An applicant must submit:

(1) A description of how the applicant will provide for day-of-flight surveillance and control of flight hazard areas, if necessary, to ensure that the presence of any member of the public in or near a flight hazard area is consistent with flight commit criteria developed for each launch as required by Flight control criteria requirements (**SASO-S450.165(b)**);

(2) A description of how the applicant will provide for any publication of flight hazard areas necessary to meet this requirement; and

(3) A description of how the applicant will establish flight commit criteria based on the results of its toxic release hazard analysis, toxic containment, or toxic risk assessment for any necessary evacuation of the public from any toxic hazard area.

SASO-S450.163 Lightning hazard mitigation

(a) An operator must:

(1) Establish flight commit criteria that mitigate the potential for a launch vehicle intercepting or initiating a lightning strike, or encountering a nearby discharge, using a means of compliance accepted by the competent authority;

(2) Use a vehicle designed to continue safe flight in the event of a direct lightning strike or nearby discharge.

(b) [reserved].

SASO-S450.165 Flight commit criteria

(a) General. For each launch, an operator must establish and observe flight commit criteria that identify each condition necessary prior to flight to satisfy the requirements of **SASO-S450.101**, and must include:

(1) Surveillance of any region of land, sea, or air in accordance with control of hazard areas requirements (**SASO-S450.161**);

(2) Monitoring of any meteorological condition necessary to:

(i) Be consistent with any safety analysis required by this regulation; and

(ii) If necessary in accordance with lightning hazard mitigation requirements (**SASO-S450.163**), mitigate the potential for a launch vehicle intercepting a lightning strike, or encountering a nearby discharge;

(3) Implementation of any launch window closure in the launch window for the purpose of collision avoidance in accordance with launch collision avoidance analysis requirements (**SASO-S450.169**);

(4) Confirmation that any safety-critical system is ready for flight;

(5) Confirmation from ENAC that the risk to critical assets satisfies the requirements of **SASO-S450.101(a)(4)** (safety criteria);

(6) Any other hazard controls derived from any safety analysis required by this regulation.

(b) Prior to any flight, an operator must assess and document that the system is ready to execute the flight within the design and operational limitations of the system.

(c) Application requirements. An applicant must submit a list of all flight commit criteria.

(d) [reserved].

SASO-S450.167 Tracking

(a) General. During the flight of a launch vehicle, an operator must measure and record in real time the position and velocity of the vehicle. The system used to track the vehicle must provide data to predict the expected impact locations of all stages and components, and to obtain vehicle performance data for comparison with the pre-flight performance predictions.

(b) Application requirements. An applicant must identify and describe each method or system used to meet the tracking requirements of paragraph (a) of this requirement.

SASO-S450.169 Launch collision avoidance analysis requirements

(a) Criteria. Except as provided in paragraph (d) of this requirement, for a suborbital launch, an operator must establish window closures needed to ensure that the launch vehicle, any jettisoned components, or payloads meet the following requirements with respect to orbiting objects, not including any object being launched:

(1) For inhabitable objects, one of three criteria below must be met:

(i) The probability of collision between the launching objects and any inhabitable object must not exceed **1×10-6**;

(ii) The launching objects must maintain an ellipsoidal separation distance of 200 km in-track and 50 km cross-track and radially from the inhabitable object; or

(iii) The launching objects must maintain a spherical separation distance of 200 km from the inhabitable object.

(2) For objects that are neither orbital debris nor inhabitable, one of the two criteria below must be met:

(i) The probability of collision between the launching objects and any object must not exceed **1×10-5**; or

(ii) The launching objects must maintain a spherical separation distance of 25 km from the object.

(3) For all other known orbital debris identified by the ENAC or other competent government entity as large objects with radar cross section greater than 1m2 and medium objects with radar cross section 0.1 m^2 to 1 m^2:

(i) The probability of collision between the launching objects and any known orbital debris must not exceed **1×10-5**; or

(ii) The launching vehicles systems must maintain a spherical separation distance of 2.5 km.

(b) Screening time. A launch operator must ensure the requirements of paragraph (c) of this requirement are met as follows:

(1) Through the entire segment of flight of a suborbital launch vehicle with maximum expected altitude above 150 km;

(2) [reserved].

(c) Rendezvous. [reserved].

(d) Exception. A launch collision avoidance analysis is not required for any launched vehicle system if the maximum planned altitude by that object is less than 150 km.

(e) Analysis. Collision avoidance analysis must be obtained for each launch from a competent National entity identified by ENAC, or another entity agreed to ENAC.

(1) An operator must use the results of the collision avoidance analysis to establish flight commit criteria for collision avoidance; and

(2) The collision avoidance analysis must account for uncertainties associated with launch vehicle performance and timing, and ensure that each window closure incorporates all additional time periods associated with such uncertainties.

(f) Timing and information required. An operator must prepare a collision avoidance analysis worksheet for each launch using a standardised format that contains the input data required by appendix A to this regulation, as follows:

(1) Except as specified in paragraphs (f)(1)(i) and (ii) of this requirement, an operator must file the input data with an entity identified in paragraph (e) of this requirement and ENAC at least 7 days before the first attempt at the flight of a launch vehicle, in accordance with ENAC procedures

(i) Operators that have never received a launch conjunction assessment from the entity identified in paragraph (e) of this requirement, must file the input data at least 15 days in advance.

(ii) ENAC may agree to or define an alternative time frame;

(2) An operator must obtain a collision avoidance analysis performed by an entity identified in paragraph (e) of this requirement, no later than 3 hours before the beginning of a launch window; and

(3) If an operator needs an updated collision avoidance analysis due to a launch delay, the operator must file the request with the entity identified in paragraph (e) of this requirement and ENAC at least 12 hours prior to the beginning of the new launch window.

SASO-S450.171 Safety at end of launch / Orbital debris mitigation

[reserved]

SASO-S450.173 Mishap plan-reporting, response and Investigation requirements

(a) General. An operator must report, respond to, and investigate mishaps as defined, in accordance with paragraphs (b) through (g) of this requirement using a plan or other written means.

(b) Responsibilities. An operator must document

(1) Responsibilities for personnel assigned to implement this requirement;

(2) Reporting responsibilities for personnel assigned to conduct investigations and for anyone retained by the operator to conduct or participate in investigations; and

(3) Allocation of roles and responsibilities between the launch operator and any site operator for reporting, responding to, and investigating any mishap during ground activities at the site.

(c) Mishap reporting requirements. An operator must

(1) immediately notify to the competent Investigation Authority any case of a mishap classified as an accident or serious incident in accordance with **Reg. (EU) 996/2010**;

(2) notify ENAC of any mishap in accordance with **Reg. (EU) 376/2014**, and

(3) submit a report of any mishap in a form and manner established by ENAC. The report must contain all pertinent informations about the condition known to the Operator including also the following, as applicable:

(i) hazardous debris impact points, including those outside a planned landing site or designated hazard area;

(ii) identification of any payload;

(iii) identification of Dangerous Goods involved in the event, whether on the vehicle, any payload, or on the ground

(iv) action taken by any person to contain the consequences of the event.

(d) Emergency response requirements. An operator must:

(1) Activate emergency response services to protect the public and property following a mishap as necessary including, but not limited to:

(i) Evacuating and rescuing members of the public, taking into account debris dispersion and toxic plumes; and

(ii) Extinguishing fires;

(2) Maintain existing hazard area surveillance and clearance as necessary to protect public safety;

(3) Contain and minimise the consequences of a mishap, including:

(i) Securing impact areas to ensure that no members of the public enter;

(ii) Safely disposing of Dangerous Goods; and

(iii) Controlling hazards at the site or impact areas.

(4) Preserve data and physical evidence; and

(5) Implement agreements with government authorities and emergency response services, as necessary, to satisfy this requirement.

(e) Mishap investigation requirements. In the event of a mishap, an operator must

(1) Investigate the root causes of the mishap; and

(2) Report investigation results to ENAC. That report shall be made in a form and manner established by ENAC.

(f) Preventative measures. An operator must identify and implement preventive measures for avoiding recurrence of the mishap prior to the next flight, unless otherwise approved by ENAC.

(g) Mishap Records. An operator must maintain records associated with the mishap in accordance with **SASO-450.219(b)**.

(h) [reserved].

SASO-S450.175 Test-induced damages

(a) Applicability. This requirement applies to licence applicants or operators seeking an optional test-induced damage exception

(b) Coordination of potential test-induced damage. Test-induced damage is not a mishap if all of the following are true:

(1) The operator coordinates with the competent authority, according to the procedures of the authority itself, potential test-induced damage before the planned activity, with sufficient time for the competent authority to evaluate the operator's proposal during the licence application procedure or the authorization modification; and

(2) The test-induced damage did not result in any of the following:

(i) Serious injury or fatality (as defined in **Reg. (EU) 996/2010**);

(ii) Damage to property not associated with the authorised activity;

(iii) Hazardous debris leaving the pre-defined hazard area; or

(3) The test-induced damage falls within the scope of activities coordinated with the competent authority in paragraph (b)(1) of this requirement.

(c) [reserved].

SASO-S450.177 Unique policies, requirements and practices

(a) Unique hazards. An operator must review operations, system designs, analysis, and testing, and identify any unique hazards not otherwise addressed by this regulation. An operator must implement any unique safety policy, requirement, or practice needed to protect the public from the unique hazard.

(b) Unique requirements. ENAC may identify and impose a unique policy, requirement, or practice as needed to protect the public health and safety.

(c) [reserved].

1.1.7 GROUND SAFETY

SASO-S450.179 Ground safety - General

(a) At a launch site, an operator must protect the public and property from adverse effects of hazardous operations and systems associated with:

(1) Preparing a launch vehicle for flight;

(2) Returning a launch vehicle to a safe condition after landing, or after an aborted launch attempt; and

(3) Returning a site to a safe condition.

(b) [reserved].

SASO-S450.181 Coordination with a site operator

(a) General. For a launch conducted from or to launch site authorised by ENAC or a launch site certified by ENAC under the regulation for the construction and use of spaceports (Reg. ENAC Spaceports [R2]), the operator of the vehicle system must coordinate with the site operator in order to ensure:

(1) Public access is controlled where and when necessary to protect public safety;

(2) Launch operations are coordinated with other launch operators and other affected parties to prevent unsafe interference;

(3) Any ground hazard area that affects the operations of a launch site is coordinated with the launch site operator; and

(4) Prompt and effective response in the event of a mishap that could impact public safety and property;

(b) Authorised or certified site operator. For a launch conducted from or to a site authorised by ENAC or certified by ENAC under regulation for the construction and use of spaceports (Reg. ENAC Spaceports [R2]), the operator of the vehicle system must coordinate with the site operator to establish roles and responsibilities for reporting, responding to, and investigating any mishap during ground activities at the site.

(c) [reserved].

(d) The vehicle system operator shall provide to the certified spaceport site operator's the approved procedures for the entering and leaving from the airspace associated with the site, in compliance with Appendix A of the Regulation for the Construction and Use of Spaceports (Reg. ENAC Spaceports [R2]).

SASO-S450.183 Explosive site plan

(a) Explosive siting requirements. For a launch conducted from or to a site exclusive to its own use, an operator must comply with the explosive siting requirements contained in regulation for the construction and use of spaceports (Reg. ENAC Spaceports [R2]).

(b) Application requirement. An applicant must submit an explosive site plan in accordance with paragraph (a) of this requirement.

SASO-S450.185 Ground hazard analysis

An operator must perform and document a ground hazard analysis, and continue to maintain it throughout the lifecycle of the launch system. The analysis must:

(a) Hazard identification. Identify system and operation hazards posed by the vehicle and ground hardware, including site and ground support equipment. Hazards identified must include the following:

(1) System hazards, including:

(i) Vehicle over-pressurization;

(ii) Sudden energy release, including ordnance actuation;

(iii) Ionising and non-ionising radiation;

(iv) Fire or deflagration;

(v) Radioactive materials;

(vi) Toxic release;

(vii) Cryogens;

(viii) Electrical discharge;

(ix) Structural failure; and

(2) Operation hazards, including:

(i) Propellant handling and loading;

(ii) Transporting of vehicle or vehicle components;

(iii) Vehicle testing; and

(iv) Vehicle or system activation.

(b) Hazard assessment. Assess each hazard's likelihood and severity;

(c) Risk acceptability criteria. Ensure that the risk associated with each hazard meets the following criteria:

(1) The likelihood of any hazardous condition that may cause death or serious injury to the public must be extremely remote; and

(2) The likelihood of any hazardous condition that may cause major damage to public property or critical assets must be remote.

(d) Risk mitigation. Identify and describe the risk elimination and mitigation measures required to satisfy paragraph (c) of this requirement.

(e) Validation and verification. Demonstrate that the risk elimination and mitigation measures achieve the risk levels of paragraph (c) of this requirement through validation and verification. Verification includes:

(1) Analysis;

(2) Test;

(3) Demonstration; or

(4) Inspection.

(f) [reserved].

SASO-S450.187 Toxic hazards mitigation for ground operations

(a) Applicability.

(1) Except as specified in paragraph (a)(2), this requirement applies to any launch vehicle, including all vehicle components and payloads, that use toxic propellants or other toxic chemicals.

(2) No toxic release hazard analysis is required for kerosene-based fuels, unless the competent authority determines that an analysis is required to protect public safety.

(b) General. Toxic release hazard analysis. An operator must:

(1) Conduct a toxic release hazard analysis in accordance with paragraph (c) of this requirement;

(2) Manage the risk of casualties that could arise from the exposure to toxic release through one of the following means:

(i) Contain hazards caused by toxic release in accordance with paragraph (d) of this requirement; or

(ii) Perform a toxic risk assessment, in accordance with paragraph (e) of this requirement, that demonstrates compliance with the risk criteria of **SASO-S450.185(c)**.

(3) Establish ground hazard controls based on the results of its toxic release hazard analysis and toxic containment or toxic risk assessment for any necessary evacuation of the public from any toxic hazard area.

(c) Toxic release hazard analysis. A toxic release hazard analysis must:

(1) Accounts for any toxic release that could occur during nominal or non-nominal launch ground operations;

(2) Includes a worst-case release scenario analysis or a maximum-credible release scenario analysis for each process that involves a toxic propellant or other chemical;

(3) Determines if toxic release can occur based on an evaluation of the chemical compositions and quantities of propellants, other chemicals, vehicle materials, and projected combustion products, and the possible toxic release scenarios;

(4) Accounts for both normal combustion products and any unreacted propellants and phase change or chemical derivatives of released substances; and

(5) Accounts for any operational constraints and emergency procedures that provide protection from toxic release.

(d) Toxic containment. An operator using toxic containment must manage the risk of casualty from the exposure to toxic release either by:

(1) Evacuating, or being prepared to evacuate, the public from any toxic hazard area, in the event of a worst-case release or maximum credible release scenario; or

(2) Employing meteorological constraints to limit a ground operation to times during which prevailing winds and other conditions ensure that the public would not be exposed to toxic concentrations and durations greater than accepted toxic thresholds for acute casualty.

(e) Toxic risk assessment. An operator using toxic risk assessment must manage the risk from any toxic release hazard and demonstrate compliance with the criteria in **SASO-S450.185(c)**. A toxic risk assessment must:

(1) Account for airborne concentration and duration thresholds of toxic propellants or other chemicals. For any toxic propellant, other chemicals, or combustion product, an operator must use airborne toxic concentration and duration thresholds identified in a means of compliance accepted by the competent authority;

(2) Account for physical phenomena expected to influence any toxic concentration and duration in the area surrounding the potential release site;

(3) Determine a toxic hazard area for each process, surrounding the potential release site for each toxic propellant or other chemical based on the amount and toxicity of the propellant or other chemical, the exposure duration, and the meteorological conditions involved;

(4) Account for all members of the public that may be exposed to the toxic release; and

(5) Account for any risk mitigation measures applied in the risk assessment.

(f) [reserved].

SASO-S450.189 Ground safety prescribed hazard controls

(a) General. In addition to the hazard controls derived from an operator's ground hazard analysis and toxic hazard analysis, an operator must comply with paragraphs (b) through (e) of this requirement.

(b) Protection of public on the site. An operator must document a process for protecting members of the public who enter any area under the control of a launch operator, including:

(1) Procedures for identifying and tracking the public while on the site; and

(2) Methods the operator uses to protect the public from hazards in accordance with the ground hazard analysis and toxic hazard analysis.

(c) Countdown abort. Following a countdown abort or recycle operation, an operator must establish, maintain, and perform procedures for controlling hazards related to the vehicle and returning the vehicle, stages, or other flight hardware and site facilities to a safe condition. When a launch vehicle does not lift off after a command to initiate flight was sent, an operator must:

(1) Ensure that the vehicle and any payload are in a safe configuration;

(2) Prohibit entry of the public into any identified hazard areas until the site is returned to a safe condition; and

(3) Maintain and verify that any flight safety system remains operational until verification that the launch vehicle does not represent a risk of inadvertent flight.

(d) Fire suppression. An operator must have reasonable precautions in place to report and control any fire caused by licensed activities.

(e) Emergency procedures. An operator must have general emergency procedures that apply to any emergencies not covered by the mishap plan of **SASO-S450.173** that may create a hazard to the public.

(f) [reserved].

SASO-S450.190 Records

(a) Except as specified in paragraph (b) of this requirement, a licensee must maintain for 5 years all records, data, and other material necessary to verify that a launch is conducted in accordance with representations contained in the licensee's application, the requirements of this regulation, and the terms and conditions contained in the licence.

(b) For any mishap a licensee must preserve all records related to the event. Records must be retained until completion of any National Safety Investigation Entity investigation and ENAC advises the licensee that the records need not be retained. The licensee must make all records required to be maintained under the regulations available to ENAC for inspection and copying.

1.2 VEHICLE SYSTEM OPERATOR LICENCE REQUIREMENTS FOR HUMAN FLIGHT OCCUPANTS SAFETY

1.2.1 SCOPE

SASO-HUM.5 General

This paragraph 1.2 prescribes additional requirements for obtaining and maintaining a licence applicable to suborbital operation with occupants on-board.

1.2.2 OBJECTIVE REQUIREMENTS FOR SUBORBITAL VEHICLE DESIGN

SASO-HUM.10 Applicability

Annex 1 to this regulation provides applicable objective requirements for establishing detailed design standards to be complied with by a suborbital vehicle system design.

SASO-HUM.15 Design management system

(a) A design management system shall be established that includes a safety management element and a design assurance element.

(b) The safety management element of the design management system shall include:

(1) The management decision-making authority, management functions, and safety responsibilities;

(2) Safety policy and related safety objectives,

(3) The techniques for identifying hazards throughout the system operative life;

(4) A method for reviewing, assessing and tracking hazards and the management of the associated risk, including taking actions to mitigate the risk and verify their effectiveness;

(5) A process that ensures the accuracy and validity of any hazard analyses;

(6) A system for collecting, investigating and analysing any event related to systems failures, malfunctions that might cause adverse effects on the occupant's survivability and implement the related corrective actions to prevent the repetition of such events;

(7) A method for measuring and monitoring the safety performance.

(c) The design assurance element of the design management system shall include:

(1) A system fro for the control and supervision of the vehicle system design;

(2) A flightworthiness function responsible for ensuring that the vehicle system design complies with the flightworthiness objectives requirements of this Annex 1 and associated detailed design standard;

(3) An independent verification function with scope of independently verifying the compliance with flightworthiness requirement of this Annex 1 and associated detailed design standard.

(d) As a part of the design management system, an Independent Monitoring Function shall be established to verify the compliance and suitability of procedures and methods implementing the design management system.

1.2.3 OBJECTIVE REQUIREMENTS FOR SUBORBITAL VEHICLE PRODUCTION

SASO-HUM.20 Production management system

The operator shall comply with the following requirements applicable to the production of the suborbital vehicle:

(a) The production organisation shall establish, implement and maintain a production management system that includes a safety management element and a quality management element, with clearly defined accountability and lines of responsibility throughout the organisation.

(b) The production management system shall:

(1) correspond to the size of the organisation, and to the nature and complexity of its activities, taking into account the hazards and associated risks inherent in those activities;

(2) be established, implemented and maintained under the direct accountability of an accountable manager.

(c) As part of the safety management element of the production management system, the production organisation shall:

(1) establish, implement and maintain a safety policy and the corresponding related safety objectives;

(2) appoint key safety personnel;

(3) establish, implement and maintain a safety risk management process to identify safety hazards entailed by its activities, evaluate them and manage associated risks, including taking actions to mitigate the risks and verify their effectiveness;

(4) establish, implement and maintain a safety assurance process that includes:

(i) the measurement and monitoring of the organisation's safety performance;

(ii) the management of changes;

(iii) the principles for the continuous improvement of the safety management;

(5) promote safety in the organisation through:

(i) training and education;

(ii) communication;

(iii) establish an occurrence reporting system in order to contribute to the continuous improvement of safety.

(d) As part of the quality management element of the production management system, the production organisation shall:

(1) ensure that each product, part or appliance produced by the organisation or by its partners, or supplied from or subcontracted to outside parties, conforms to the applicable design data and is in condition for safe operation;

(2) establish, implement and maintain, as appropriate control procedures for:

(i) document issue, approval or change;

(ii) vendor and subcontractor assessment audit and control;

(iii) verifying that incoming products, parts, materials and equipment, including items supplied new or used by buyers of products, are as specified in the applicable design data;

(iv) identification and traceability;

(v) manufacturing processes;

(vi) inspection and testing;

(vii) the calibration of tools, jigs, and test equipment;

(viii) non-conforming item control;

(ix) coordination with the organisation responsible for the design of the vehicle;

(x) the completion and retention of records;

(xi) the competence and qualifications of personnel;

(xii) the issue of production conformity documents;

(xiii) handling, storage and packing;

(xiv) internal quality audits and the resulting corrective actions;

(xv) work performed at external locations.

(3) include specific provisions in the control procedures for any critical parts.

(e) The production organisation shall establish, as part of the production management system, an independent monitoring function to verify compliance of the organisation with the relevant requirements of this regulation as well as compliance with and adequacy of the production management system. Monitoring shall include feedback to the key safety persons and to the accountable manager to ensure, where necessary, the implementation of corrective action.

(f) The production management system may be integrated with that required under other requirements of this regulation.

SASO-HUM.25 Acceptance of hardware

(a) Each system shall be functionally demonstrated while exposed to no less than its maximum expected operating environment to demonstrate that it is free of defects, free of integration and workmanship errors, and ready for operational use.

(b) As an alternative, in-process controls and a quality assurance process can be combined to ensure functional capability of each safety-critical system during its service life.

SASO-HUM.30 Configuration management

A process shall be implemented that provides configuration control over safety critical systems manufacturing.

1.2.4 OBJECTIVE REQUIREMENTS FOR LAUNCH VEHICLE OPERATIONS

SASO-HUM.35 Flight crew decision authority

An operator must designate a member of the flight crew who has ultimate decision authority on the vehicle. This flight crew member is responsible for the safe operation of the vehicle and for the safety of occupants.

SASO-HUM.40 Operating within constraints

An operator shall operate the system within the most current documented operating limitations and procedures.

SASO-HUM.45 Operations products

All products that are necessary to operate the system, such as plans, procedures, processes, schedules, and supporting information, must be current and consistent with the operating limits of the system.

SASO-HUM.50 Procedures

Refer to **SASO-HUM.155(c)**.

SASO-HUM.55 Integrated operations coordination

Refer to **SASO-HUM.155(d)**.

SASO-HUM.60 Fatigue management

An operator shall manage flight crew, ground controller, and safety-critical ground operations personnel fatigue through training and duty limitations as follows:

(a) Flight crew, ground controllers, and safety-critical ground operations personnel shall receive training that makes each of them aware of the signs of fatigue, the effects of fatigue on performance, and fatigue countermeasures.

For that purpose the operator, after the organization of appropriate courses (initial and recurrent training) with the scope of information, training and staff awareness, shall establish and implement a specific "Support Programme" that is aimed to provide assistance and support to the above staff for recognising, addressing and overcoming, through the "peer" group and/or the MHP (Mental Health Professional) professionals support, any issues that may affect the capability to safely exercise the license and/or qualification privileges;

(b) Duty limitations must be applied to flight crew, ground controllers, and safety-critical ground operations personnel to ensure they are physiologically and mentally capable of performing safety-critical operations.

SASO-HUM.65 Cabin hygiene

An operator must implement cabin hygiene procedures and processes to prevent occupant exposure to microbial contamination and foreign object debris, which could lead to an incapacitating illness or serious injury.

SASO-HUM.70 Launch commit criteria and flight rules

An operator shall document operational rules and criteria that identify the system's condition and the capability that should exist in order to safely ingress the vehicle, begin the flight, remain in flight, reenter (if applicable), and egress the vehicle.

SASO-HUM.75 Communications protocol

All flight crew, ground controllers, and safety-critical ground operations personnel must adhere to a defined communications protocol when executing safety-critical operations. Refer also to **SASO-S450.157**.

SASO-HUM.80 Consumables

For suborbital flight, an operator shall carry on-board consumable quantities sufficient to cover planned flight duration plus margin to account for variables in usage.

SASO-HUM.85 Early end of flight

Once a safety-critical function becomes zero failure tolerant, an operator must end the flight as soon as practicable, normally at the next available primary or alternate landing site.

SASO-HUM.90 Collision avoidance

For higher flights with an expected maximum height equal to or greater than 150 km, an operator shall not perform the launch if the probability of collision with any known orbital object would exceed 1E-6.

SASO-HUM.95 Atmospheric conditions

Refer to **SASO-A1-1.100** set forth in Chapter 1 of Annex 1 of this regulation.

SASO-HUM.100 Food and water

Refer to **SASO-A1-1.101** set forth in Chapter 1 of Annex 1 of this regulation.

SASO-HUM.105 Body waste and vomitus management

Refer to **SASO-A1-1.103** set forth in Chapter 1 of Annex 1 of this regulation.

SASO-HUM.110 Emergency operations management

An operator shall develop and execute a plan to manage system emergencies, including:

(a) Launch escape, if applicable;

(b) Occupant rescue and recovery;

(c) Contacting, and providing necessary vehicle information to, emergency responders to aid in preserving life and treating the injured; and

(d) Preservation of data and physical evidence for use in any anomaly or accident investigation.

SASO-HUM.115 Maintenance and preventive maintenance

An operator should perform and document maintenance and preventive maintenance for both hardware and software in accordance with the Operational Documentation to ensure readiness for safe flight.

SASO-HUM.120 Configuration management

A process shall be implemented that provides configuration control over safety-critical systems design, manufacturing, and operations throughout the system's life.

SASO-HUM.125 Quality assurance

The system shall be manufactured, maintained, and operated in accordance with a quality assurance process that ensures the system meets design specifications and safety requirements.

SASO-HUM.130 Informing crew of risk

An operator must inform in writing any individual, serving as crew, on the residual risks of the operation as mitigated by conditions and limitations of the relevant authorization. An operator must provide this information:

(a) Before entering into any contract or other arrangement to employ that individual; or

(b) For any crew member employed before the date of applicability of this regulation, as early as possible and prior to any launch in which that individual will participate as crew.

SASO-HUM.135 Environmental control and life support systems

An operator must provide atmospheric conditions adequate to sustain life and consciousness for all inhabited areas within a vehicle. The operator or flight crew must monitor and control the following atmospheric conditions in the inhabited areas or demonstrate through the licence or permit process that an alternate means provides an equivalent level of safety.

SASO-HUM.140 Smoke detection and fire suppression

An operator or crew must have the ability to detect smoke and suppress a cabin fire to prevent incapacitation of the flight crew.

SASO-HUM.145 Human factors

An operator must take the precautions necessary to account for human factors that can affect a crew's ability to perform safety-critical roles.

For that purpose, the operator shall establish and implement the "Support Programme" for allowing, facilitating and ensuring to all staff the access to the program in a "proactive" and not punitive manner according to the principles of "Just culture".

SASO-HUM.150 Verification program

An operator must successfully verify the integrated performance of a vehicle's hardware and any software in an operational flight environment before allowing any flight participant on-board during a flight. Verification must include flight testing.

SASO-HUM.155 Operator informing flight participant of risk

(a) Before receiving compensation or making an agreement to fly a flight participant, an operator must satisfy the requirements of this paragraph. An operator must inform each flight participant in writing about the residual risks of the launch, including the safety record of the launch vehicle type as mitigated by conditions and limitations of the relevant authorization. An operator must present this information in a manner that can be readily understood by a flight participant, and must disclose in writing:

(1) For each mission, each known hazard and residual risk that could result in a serious injury, death, disability, or total or partial loss of physical and mental function;

(2) That there are hazards that are not known; and

(3) That participation in flight may result in death, serious injury, or total or partial loss of physical or mental function.

(b) [reserved]

(c) An operator must inform each flight participant of the safety record of all launch vehicles that have carried one or more persons on-board, including both government and private sector vehicles. This information must include:

(1) The total number of people who have been on a suborbital flight and the total number of people who have died or been seriously injured on these flights; and

(2) The total number of launches conducted with people on-board and the number of catastrophic failures of those launches.

(d) An operator must describe the safety record of its vehicle to each flight participant as follows:

(1) For licences and FCOA issued under this regulation, the operator's safety record must cover any mishap event that occurred during and after vehicle verification performed in accordance with **SASO-HUM.150**, and include:

(i) The number of vehicle flights;

(ii) The number of mishaps; and

(iii) Whether any corrective actions were taken to resolve these mishaps.

(2) For experimental permit issued under this regulation, the operator's safety record must cover launch accidents and incidents, that occurred during and after vehicle verification performed in accordance with **SASO-HUM.150**, and include:

(i) The number of vehicle flights;

(ii) The number of accidents incidents; and

(iii) Whether any corrective actions were taken to resolve these accidents and incidents.

1.2.5 MEDICAL AND TRAINING REQUIREMENTS FOR PARTICIPANTS

SASO-HUM.160 Flight participants' medical requirements

(a) General. Participant shall be free from any:

(1) abnormality, congenital or acquired;

(2) active, latent, acute or chronic disease or disability;

(3) wound, injury or sequelae from operation; and effect or side effect of any prescribed or non-prescribed therapeutic, diagnostic or preventive medication taken that would entail a degree of functional incapacity which might lead to incapacitation or an inability to discharge their safety duties and responsibilities. Additional medical testing may be recommended by the examining physician and should be obtained if clinically indicated, in particular if the acceleration profile will expose to greater than +4Gz.

(b) Content of aero-medical assessments:

(1) Participant aero-medical assessment shall include at least:

(i) an assessment of the participant medical history, also under the psicological profile and of critical events stress management; and

(ii) a clinical examination of the following:

(A) cardiovascular system;

(B) respiratory system;

(C) musculoskeletal system;

(D) otorhino-laryngology;

(E) visual system;

(F) colour vision; and

(G) detection test on use of psychoactive substances and/or alcohol.

(2) Each subsequent aero-medical re-assessment shall include:

(i) an assessment of the participants medical history, also under the psicological profile and of critical events stress management; and

(ii) a clinical examination if deemed necessary in accordance with aero-medical best practice.

(3) For the purpose of (b)(1) and (b)(2), in case of any doubt or if clinically indicated, a participant aero-medical assessment (SFP) shall also include any additional medical examination, test or investigation that are considered necessary by the AME, AeMC (Aeromedical Center).

SASO-HUM.165 Flight participant training

The vehicle system operator must train, also under the psicological profile for the critical events stress management, each flight participant before flight on how to respond to emergency situations, including smoke, fire, loss of cabin pressure, and emergency exit.

1.2.6 QUALIFICATION, TRAINING AND MEDICAL REQUIREMENTS OF FLIGHT CREW

SASO-HUM.170 Crew medical certification

(a) Each flight crew member with a safety-critical role must possess and carry an EASA class 1 medical certificate issued in accordance with Part-MED (**Reg. (EU) 1178/2011** and following changes **Reg. (EU) 2019/27**, requirement MED.B 055 “Mental Health”), no more than 12 months prior to the month of launch.

(b) Each flight crew member without a safety-critical must fulfil the requirements of paragraph 1.2.4 of this regulation.

SASO-HUM.175 Crew qualifications and training

(a) Each crew member must:

(1) Complete training on how to carry out his or her role on-board or on the ground so that the vehicle will not harm the public; and

(2) Train for his or her role in nominal and non-nominal conditions.

(b) [reserved].

(c) A pilot and a remote operator must:

(1) Possess and carry an EASA CPL (A) pilot certificate with an instrument rating.

(2) Possess aeronautical knowledge, experience, and skills necessary to pilot and control the launch vehicle that will operate in the National Airspace System. Aeronautical experience may include hours in flight, ratings, and training.

(3) Receive vehicle and mission-specific training for each phase of flight by using one or more of the following:

(i) A method or device that simulates the flight;

(ii) An aircraft whose characteristics are similar to the vehicle or that has similar phases of flight to the vehicle;

(iii) Flight testing; or

(iv) An equivalent method of training approved by ENAC through the licence or permit process.

(4) Receive from the operator the specific initial training and the subsequent expected updates in terms of “Support Programme”;

(5) Train in procedures that direct the vehicle away from the public in the event the flight crew abandons the vehicle during flight; and

(6) Train for each mode of control or propulsion, including any transition between modes, such that the pilot or remote operator is able to control the vehicle.

(d) A pilot or a remote operator may demonstrate an equivalent level of safety through the licence or permit process.

(e) [reserved].

SASO-HUM.180 Crew resource management and communication

Training for flight crew and ground controllers should include clear definitions of roles and responsibilities, use of a defined communications protocol, and crew resource management techniques.

SASO-HUM.185 Operator training of crew

(a) Implementation of training. An operator must train each member of its crew and define standards for successful completion in accordance with the crew training program.

(b) Training device fidelity. An operator must:

(1) Ensure that any crew-training device used to meet the training requirements realistically represents the vehicle's configuration and mission, or

(2) Inform the crew member being trained of the differences between the two.

(c) Maintenance of training records. An operator must continually update the crew training to ensure that it incorporates lessons learned from training and operational missions. An operator must:

(1) Track each revision and update in writing; and

(2) Document the completed training for each crew member and maintain the documentation for each active crew member.

(d) Current qualifications and training. An operator must establish a recurrent training schedule and ensure that all crew qualifications and training required are current before launch.

SASO-HUM.190 Suborbital flight crew aero-physiological training

(a) Each crew member must demonstrate the ability to withstand the stresses of space flight while still safely performing his/her duties. The present regulation gives general guidance to approach with the aero-physiological training for suborbital flights, leaving to operators the responsibility to define the details of the training program (theoretical and practical), what kind of equipment and facilities to use (human centrifuge, high-performance altitude chamber, zero-G parabolic flights, etc.) and the acceptable performance evaluation requirements.

(b) Aero-physiological training plans and schedules must be included in the Safety Management System manual of the operator and approved by ENAC.

(c) Physiological training must be tailored to account for specific vehicle types and mission profiles and must consider the different individual roles on-board (pilots/crewmember, passenger). Physiological training of a pilot/crewmember is not meant for further selection but as preparation for the missions and to safely cope with emergencies.

(d) [reserved].

(e) [reserved].

(f) [reserved].

1.2.7 QUALIFICATION, TRAINING AND MEDICAL REQUIREMENTS OF GROUND CREW, REMOTE PILOT INCLUDED

[reserved]

2 OPERATIONS UNDER FCOA REQUIREMENTS

SASO-FCOA.5

A Foreign Country Operator Authorization (FCOA) may be issued by ENAC to a vehicle system operator with a valid licence issued by a foreign country with which ENAC or the Italian Government has entered into a bilateral agreement, recognized in accordance with the associated Technical Implementation Procedures.

SASO-FCOA.10

The vehicle system operator shall comply with:

(a) the requirements of this regulation not covered by the licence referred in **SASO-FCOA.5**

(b) and with any applicable Italian law and regulation

(c) any additional conditions and limitations deemed adequate by ENAC

(d) Appendix A of the Reg. ENAC Spaceports [R2]

SASO-FCOA.15

The vehicle system operations under FCOA may be carried out only in a suitable spaceport certified in accordance with Reg. ENAC Spaceports [R2].

SASO-FCOA.20

(a) The vehicle system operator shall comply with the insurance requirements specified in **SASO-INS.15**.

(b) The vehicle system operator shall provide to the spaceport operator the data and information related to the operation that intends to carry out, as specified in **SASO-FCOA.10(d)**.

SASO-FCOA.25

A Foreign Country Operator Authorization may be issued only after ENAC has verified:

(a) the vehicle system operator has complied with **SASO-FCOA.5**, **SASO-FCOA.10**, **SASO-FCOA.15** and **SASO-FCOA.20**, and

(b) the launch operations would not jeopardise public health and safety, national security or foreign policy interests, or international obligations of Italy.

(c) the vehicle system operator has provided to the spaceport operator the data and information related to the operation that intends to carry out, as specified in **SASO-FCOA.10(d)**.

3 EXPERIMENTAL PERMIT REQUIREMENTS

SASO-EXP.5

An experimental permit can be issued to a vehicle system operator for:

(a) Suborbital operations carried out from/in an identified launching/take-off or re-entry/landing site located in the Italian territory.

(b) A single operation, that may include one or more flights, conducted in accordance with the prescribed conditions and limitations, as specified in the experimental permit.

SASO-EXP.10

An experimental permit can be issued for the scope referred in **SASO-EXP.5** only after the applicant has demonstrated compliance with the requirements set forth in this paragraph.

SASO-EXP.15

(a) The experimental permit can be issued followed a positive evaluation of a risk assessment that shall take into account all the foreseeable hazards related to the operations to be performed, including those related to training, crew skill and medical aspects.

(b) The applicant must substantiate and provide to ENAC with a sufficient level of confidence that the hazards related to the operations to be carry out will be effectively controlled and mitigated to reduce the risks to an acceptable level.

SASO-EXP.20

(a) As part of risk assessment referred in **SASO-EXP.10,** the applicant must comply as far as practical with the applicable technical requirements set forth in Section III and Annex 1 of this regulation, including **SASO-S450.101**.

(b) Compliance with the public risk criteria of **SASO-S450.101** can be demonstrated by using compensating factors, conditions, limitations or other mitigating measures that ensure an Equivalent Level of Safety (ELOS) in accordance with **SASO-GEN.20(c)**.

SASO-EXP.25

(a) The operations under an experimental permit can be carried out either:

(i) in a spaceport certified under the Reg. ENAC Spaceports [R2], or

(ii) in suitable launching/take-off and re-entry/landing sites.

(b) If the operation under the experimental permit is carried out in a certified spaceport referred in point (a)(i), the vehicle system operator shall provide to the spaceport operator the data and information related to the operation that intends to carry out, as specified in **SASO-EXP.30(b)**.

(c) If the operation under the experimental permit is carried out in one or more sites referred in point (a)(ii):

(1) the risk assessment of **SASO-EXP.10** shall consider, and effectively control and mitigate, all the foreseeable ground and airspace hazards associated to the sites and to the activities to be carried out within the sites, to demonstrate a level of safety equivalent to that of the Reg. ENAC Spaceports [R2].

(2) the vehicle system operator is responsible to the site's activities for the duration of the operation under the experimental permit.

SASO-EXP.30

The vehicle system operator shall comply with:

(a) the insurance requirements specified in **SASO-INS.10**;

(b) Appendix A of the Reg. ENAC Spaceports [R2], in case of operations carried out in a certified spaceport.

SASO-EXP.35

Only flight crew or flight participants strictly needed to accomplish tasks required by the scope of the operation are admitted on-board the vehicle during the operation authorized under an experimental permit.

4 AIRSPACE TRAFFIC MANAGEMENT (ATM) COORDINATION

SASO-ATM.5 Operation procedures and working methods agreements

(a) A vehicle system operator shall enter into, and comply with, a written agreement with ENAC and other involved entities, to define operational procedures and working methods to be applied during the entire life cycle of the operation for the safe access and use of the airspace including higher airspace. The agreement describes as follow:

(1) the lifecycle of the operation from the strategic planning until the end of flight execution with the chronology of events including go-no-go decisions;

(2) the flight trajectory profile in terms of list of vehicle's 6D performance data, flight window, flight duration, flight delay, contingency types and frequencies;

(3) the vehicle system characteristics, in terms of the automation and authonomy of the vehicle system decision making capability (including anti-collision and separation capability), the support CNS system performances;

(4) the airspace volume occupation and solutions for achieving separation with other airspace users.

(b) The agreement referred to in point (a) shall report how the impact on the network is mitigated (impact assessment of the operation).

(c) The agreement referred to in point (a) shall clarify roles and responsibility of involved parties, including procedures and working methods, in case of nominal and emergency situations.

SASO-ATM.10 Supporting services

(a) The vehicle system operator shall enter into a written agreements with service provider(s) recognized by ENAC to ensure a safe conduct of the operation. Supporting services include the following:

(1) Management services of multiple concurrent suborbital and/or access to space operations.

(2) Meteorological services (actual conditions and forecasts), including space weather information;

(3) Geographic data sharing services;

(4) Communication services with other involved entities and navigation and surveillance services;

(5) Conformance monitoring services of flight to the planning;

(6) Collision avoidance analysis and services, in case **SASO-S450.169(f)** applies;

(7) Any other other relevant service needed to carry out a safe operation, to be agreed with ENAC.

5 INFRASTRUCTURE AND SERVICES INTERFACES

SASO-INT.5

The vehicle system operator shall demonstrate that its operations are compatible with the take-off/launch or landing/re-entry site capabilities, characteristics and procedures, and can be carried out in a safe and secure manner.

SASO-INT.10

The vehicle system operator shall provide the take-off/launch or landing/re-entry site operator with the operation authorization referred to in **SASO-GEN-5**.

SASO-INT.15

The vehicle system operator shall provide the take-off/launch or landing/re-entry site operators, any information related to its operation and tasks, including those carried out by subcontractors, necessary to ensure that the site operations are performed in a safe and secure manner.

SASO-INT.20

In case the vehicle operations may interfere with airport operations or other site operations, the vehicle system operator shall coordinate with the take-off/launch or landing/re-entry site operators and all the other relevant entities including airspace service providers, in order to identify and reserve the take-off/launch or landing/re-entry slots allocated to its operations.

SASO-INT.25

In case vehicle operations are carried out in a spaceport certified under the ENAC regulation on construction and use of spaceports [R2], the vehicle system operator shall participate in and be part of the safety system organisation required by the Spaceports Regulation with regard of risks of fire, explosion, chemical contamination and environmental pollution assessment and mitigation.

6 ENVIRONMENTAL COMPATIBILITY

SASO-ENV.5 Environmental impact assessment

In addition to the environmental requirements of Section II and Section III paragraph 1.1 of this regulation, an environmental impact assessment, agreed with ENAC, shall be requested in order to determine the risk to the environmental elements (atmosphere, water and soil) derived from the emissions and noise generated by the vehicle during its operation and establish suitable prevention and mitigation measures to reduce such risk to acceptable levels.

7 MISCELLANEA

7.1 SAFETY APPROVAL FOR PARTS AND SYSTEMS

[reserved]

7.2 SECURITY REQUIREMENTS

SASO-SEC.5 Scope of security measures

The following security measures apply to operations originating from a spaceport. For any operations originating outside a spaceport, the security measures will be defined by the operator in agreement with ENAC based on a risk assessment and site characteristics.

SASO-SEC.10 Security programme of the vehicle system operator

(a) The operator shall draw up, apply and maintain his own security programme in which the security measures will be identified through specific risk assessment and will be implemented through the corresponding risk management.

(b) The programme shall also identify and protect the critical information and communications technology systems and data from cyber-attacks and contains detailed measures to protect such systems and data from unlawful interference.

(c) The security programme of the vheicle system operator is submitted to ENAC for approval.

(d) The general principles contained in the **Reg. (EU) 2015/1998** (Security Regulation) and the National Civil Aviation Security Programme (NCASP) apply to the operator security programme.

SASO-SEC.15 Security manager of the vehicle system operator

(a) The person responsible for implementing and monitoring the measures in the operator security program is the security manager.

(b) The operator security manager has the role, responsibilities and requirements set out for this figure in EU security regulation and the NCASP.

(c) The security manager of the vehicle sistem operator shall work in coordination with the spaceport and airport security manager, if different.

SASO-SEC.20 Mission control centre

The operator shall ensure that the Mission Control Centre, as defined in art. 2.10 of ENAC regulations for the construction and use of spaceports, is adequately protected in order to prevent the access of unauthorised persons.

SASO-SEC.25 Security screening of persons other than flight participants and the items carried

The security provisions contained in the NCASP, as provided in Article 8.4 of ENAC regulations for the construction and use of the spaceports, shall apply to the screening of persons other than participants and the items carried.

SASO-SEC.30 Security screening of flight participants and their belongings

(a) The operator shall ensure that the provisions set forth in the NCASP for passengers and their baggage are applied to the screening of participants and their items.

(b) A flight participant may not carry on-board any explosives, firearms, knives or other weapons or other prohibited items listed in Appendix 4-C of the Security Regulation.

SASO-SEC.35 Operator staff

The operator staff with access to spaceport facility shall:

(a) Have successfully completed an enhanced background check.

(1) A background check means a check of a person's identity and previous experience, including any criminal history.

(2) As for point 1.2.3.1.1 of the NCASP, the enhanced background check is subject to an ongoing review mechanism.

(3) In line with the applicable rules of European Union and national law, an enhanced background check must meet the requirements laid down in point 11.1.3 of the **Reg. (EU) 2015/1998**.

(4) In addition, persons having administrator rights or unsupervised and unlimited access to critical information and communications technology systems and data used for the security of the operations have successfully completed an enhanced background check.

(b) Have completed initial and recurrent security training to be aware of their security responsibilities.

(1) Recurrent training must have a frequency sufficient to ensure that competencies are maintained and acquired in line with security developments.

(2) Staff training must also include cybersecurity knowledge appropriate to their role and responsibilities within the organisation.

SASO-SEC.40 Vehicle's security

An operator shall ensure the implementation of the security measures as regards its vehicle in accordance with the Security Regulation, as applicable.

SASO-SEC.45 Vehicle's security search

(a) A vehicle shall at all times be subjected to a security search whenever there is reason to believe that unauthorised persons may have had access or tampered with it.

(b) The list of prohibited articles for vehicle aircraft security searches is the same as the one set out in Attachment 1-A of Security Regulation.

(c) When to perform a vehicle security search, the provisions set forth in point 3.1.2. of the Security Regulation shall apply to the extent possible.

SASO-SEC.50 Vehicle's security protection

(a) The operator shall ensure the security of their vehicles parked in the spaceport and protect each of the exterior doors (if any) from unauthorised access:

(1) ensuring that persons seeking to gain unauthorised access are challenged promptly; or

(2) having the external door closed; or

(3) having electronic means which will immediately detect unauthorised access.

(b) Where external doors are closed unless the vehicle is parked in a hangar that is locked or otherwise protected from unauthorised access, each external door (if any) shall also:

(1) have access aids removed; or

(2) be sealed; or

(3) be locked; or

(4) be monitored.

SECTION IV - REQUIREMENTS FOR AERO LAUNCHING INTO ORBIT OPERATIONS

[reserved]

SECTION V - REQUIREMENTS FOR RE-ENTRY FROM ORBIT OPERATIONS

[reserved]

APPENDIX A - COLLISION ANALYSIS WORKSHEET

This Appendix is applicable for suborbital flights with apogee above 150 km or where the encounter with orbital debris is not extremely improbable, and for access to space and re-entry from orbit flights.

(a) Launch information. An operator must file the following information:

(1) Mission name and launch location. A mnemonic given to the launch vehicle/payload combination identifying the launch mission from all others. Launch site location in latitude and longitude;

(2) Launch window. The launch window opening and closing times in Greenwich Mean Time (referred to as ZULU time) and the Julian dates for each scheduled launch attempts including primary and secondary launch dates;

(3) Epoch. The epoch time, in Greenwich Mean Time (GMT), of the expected launch vehicle liftoff or takeoff time;

(4) Segment number. A segment is defined as a launch vehicle stage or payload after the thrusting portion of its flight has ended. This includes the jettison or deployment of any stage or payload.

(5) [reserved]

(6) [reserved]

(7) Time of powered flight and sequence of events. The elapsed time in hours, minutes, and seconds, from liftoff or takeoff to passivation or disposal. The input data must include the time of powered flight for each stage or jettisoned component measured from liftoff or takeoff; and

(8) Point of contact. The person or office within an operator's organisation that collects, analyses, and distributes collision avoidance analysis results.

(b) Collision avoidance analysis results in transmission medium. An operator must identify the transmission medium, such as voice or e-mail, for receiving results.

(c) Deliverable schedule/need dates. An operator must identify the times before flight, referred to as "L-times," for which the operator requests a collision avoidance

analysis. The final collision avoidance analysis must be used to establish flight commit criteria for a launch.

(d) Trajectory files. Individual position and velocity trajectory files, including:

(1) The position coordinates in the Earth-Fixed Greenwich (EFG) coordinates coordinate system measured in kilometres and the EFG velocity components measured in kilometres per second, of each launch vehicle stage or payload starting below 150 km through screening time frame;

(2) Radar cross section values for each individual file;

(3) Covariance, if probability of impact analysis option is desired; and

(4) Separate trajectory files identified by valid window time frames, if launch trajectory changes during launch or reentry window.

(e) Screening. An operator must select spherical, ellipsoidal, or collision probability screening as defined in this paragraph for determining any conjunction:

(1) Spherical screening. Spherical screening centres a sphere on each orbiting object's centre-of-mass to determine any conjunction;

(2) Ellipsoidal screening. Ellipsoidal screening utilises an impact exclusion ellipsoid of revolution centred on the orbiting object's centre-of-mass to determine any conjunction. An operator must provide input in the UVW coordinate system in kilometres. The operator must provide delta-U measured in the radial-track direction, delta-V measured in the in-track direction, and delta-W measured in the cross-track direction; or

(3) Probability of Collision. Collision probability is calculated using position and velocity information with covariance in both position and velocity.

ANNEX 1 – DESIGN REQUIREMENTS FOR VEHICLE SYSTEMS WITH OCCUPANTS ON-BOARD

Notes

This Annex 1 contains the basic requirements that shall be taken into account for the design of a vehicle system or of a vehicle with occupants on-board, including the pilot, intended to carry out a suborbital, access to space, or re-entry operation.

These basic requirements are deliberately general in order to address the different tipologies of vehicle systems and vehicles, and they shall be used as reference to the development of the design-detailed requirements applicable to the specific vehicle system.

Design-detailed requirements may be developed by different entitiesand standardization bodies, but in any case they must be submitted and approved by the authority that, if deemed appropriate, it may provide any changes or additions in order to ensure the comply with the basic requirements of this Annex 1.

It is agreed that the contents of this Annex 1, may be subject to review and update, when appropriate, in order to guarantee the cotinuous allignment with the possible technological evolution of transport systems. Further extensions may be provided for vehicles systems or vehicles with occupants, but without crew on-board.

It should also be noted that the methodology followed for the development of the basic requirements of this Annex 1 is in line with the principles that have been applied in aviation field in last years for the development of "new generation" airworthiness requirements for general aviation (ref. FAA FAR-23 Amdt. 23-64, and EASA CS-23 Amdt. 5) and UAS (ref. JARUS CS-UAS).

Unless otherwise specified, in this Annex 1, whenever the "vehicle" word is used, it must be intended as "vehicle system".

SASO-A1-0 General

(a) The basic requirements of this Annex 1 are applicable to vehicles systems used for human transport, and with pilot on-board.

(b) The aircraft used as carrier of air launched systems shall comply, other than basic requirements of this Annex 1, also to the objective requirements of the **EASA CS-23 Amdt. 5**. In any case, it is agreed that the basicrequirements of this Annex 1 take precedence to the ones of the **EASA CS-23 Amdt. 5**.

Chapter 1 - HUMAN NEEDS AND ACCOMMODATION

SASO-A1-1.100 Atmospheric conditions

(a) The vehicle should provide atmospheric conditions to all occupants adequate to protect them from injuries and allow safety-critical operations to be performed.

(b) If needed to achieve the objective of paragraph (a), the flight crew or ground controllers shall be able to monitor and control the following atmospheric conditions in the inhabited areas:

(1) Composition of the atmosphere and any revitalization;

(2) Pressure, temperature, and humidity;

(3) Contaminants that include particulates;

(4) Any harmful or hazardous concentrations of gases, vapors, combustion byproducts, and biological agents; and

(5) Ventilation and circulation.

SASO-A1-1.101 Food and beverages

(a) Direct and indirect hazards associated to the type and the consumption of food and beverages on-board shall be assessed in order to avoid injury to occupants and reduction of flight crew performance of safety-critical operations.

(b) Any food and beverages provided to the occupants for consumption should be handled, stored, and dispensed to protect against illness or injury.

SASO-A1-1.103 Body waste and vomitus management

The system shall manage and contain body waste and vomitus to protect all occupants from injury and allow safety-critical operations to be performed.

SASO-A1-1.105 Emergency survival equipment and supplies

(a) The vehicle shall include emergency survival equipment and supplies that provide a reasonable chance of survival of all occupants for post-landing emergencies.

(b) The type of equipment and supplies shall be adequate to the expected operational scenario and potential emergency landing sites.

Chapter 2 - OCCUPANT PROTECTION

SASO-A1-2.100 General

The criteria provided under NASA-STD-3001 Volume 2 Revision B Section 6 represent an acceptable means of compliance to the occupant protection requirements from exposure to acceleration, vibration, radiation and noise of this Annex 1.

SASO-A1-2.101 Acceleration protection

The vehicle shall be designed to limit occupant exposure to transient and sustained linear and angular acceleration such that occupants are protected from injuries and safety-critical tasks can be performed as intended, with an acceptable work load for occupants in charge of performing safety-critical tasks.

SASO-A1-2.103 Vibration protection

The vehicle shall be designed to limit occupant exposure to vibration such that occupants are protected from injuries and safety-critical tasks can be performed as intended without excessive workload for the crew and occupants in charge of performing safety-critical tasks.

SASO-A1-2.105 Radiation protection

The vehicle shall be designed to protect the occupants from adverse health effects due to the exposure to the following types of radiation:

(a) Radiofrequency non ionizing radiation;

(b) Near infrared, visible and ultraviolet radiation;

(c) Ionizing radiation, for flight crew only.

SASO-A1-2.106 Noise protection

In order to protect the occupants from injuries and to ensure the conduction of safety-critical operations as intended, without excessive workload for the crew and occupants in charge of performing safety-critical operations, the vehicle shall be designed to limit occupant exposure to noise.

SASO-A1-2.107 Mechanical hazards protection

In order to protect the occupants from injuries and to ensure no interference with the conduction of safety-critical operations as intended, without excessive workload for the crew and occupants in charge of performing safety-critical operations, the hazard associated to the following elements shall be considered in the vehicle design:

(a) Moving parts;
(b) Entrapment;
(c) Stored potential energy;
(d) Burrs;
(e) Pinch points;
(f) Sharp edges;
(g) Sharp items; and
(h) Temperature.

SASO-A1-2.109 Orthostatic protection

The vehicle should provide orthostatic intolerance countermeasures to the extent necessary for occupants to perform safety-critical tasks.

SASO-A1-2.111 Medical equipment and supplies

The vehicle should have first aid and medical equipment and supplies for treatment of injuries or medical emergencies that might occur during flight, consistent with the design reference mission and the number of occupants.

SASO-A1-2.113 Fire event detection and fire suppression

(a) The system shall be designed to minimize the risk of initiation and propagation of the fire within the vehicle, and the generation of smoke gases.

(b) The system should have the ability to detect a fire event and/or smoke generation within the habitable volume and alert the occupants.

(c) The vehicle or an occupant should have the ability to extinguish a fire in the habitable volume.

SASO-A1-2.115 Emergency response to contaminated atmosphere

The vehicle shall have the capability and provide equipment and provisions to detect, monitor and limit occupant exposure to the contaminated atmosphere in order to avoid serious injuries and to ensure safety-critical operations can be performed as intended, without excessive workload for the crew and occupants in charge of performing safety-critical operations.

Specific vehicle design features and emergency procedures shall be foreseen in order to protect occupants from contaminated atmosphere in accordance with the relevant level of protection. The equipment and provisions shall provide, even in emergency conditions, as necessary:

(a) breathable air and eye protection for each occupant;

(b) voice communication between the flight crew and the ground controllers;

(c) voice communication between the flight crew and the participants.

SASO-A1-2.117 Emergency response to loss of cabin pressure integrity

In the event cabin pressure integrity is lost, the vehicle shall be designed to prevent incapacitation of flight crew and serious injury of occupants by providing:

(a) Enough pressurant gases to maintain cabin pressure for a sufficient time to carry out a safe recovery of the occupants; or

(b) A pressure suit or other equivalent system that makes available environmental control and life support capability for the occupants.

SASO-A1-2.119 Emergency response – Abort and escape

(a) The system shall provide the capability to abort, during all phases of flight.

(b) The system shall provide the capability to escape at least during the pre-flight and post-flight phases, in accordance with the intended type of operation.

Chapter 3 - FLIGHTWORTHINESS

SASO-A1-3.100 System safety and failure tolerance

(a) The vehicle system shall control hazards in a manner commensurate with their severity and likelihood in order to reach an acceptable level of risk associated to those hazards;

(b) Hazards that can lead to catastrophic events shall be controlled with no less than single failure tolerance;

(c) When failure tolerance adds complexity that results in a decrease in the overall system. safety or when failure tolerance is not practical, an equivalent level of safety must be achieved through design for minimum risk.

SASO-A1-3.101 Limitations on failure tolerance

The vehicle system shall provide failure tolerance capability without:

(a) [reserved]

(b) Relying upon in-flight maintenance of safety-critical equipment under time-critical situations;

(c) Using emergency equipment; or

(d) Using a launch escape system.

SASO-A1-3.103 Separation of redundant systems

The vehicle design shall be such that the redundant safety-critical systems and subsystems are sufficiently separated and protected so that an unexpected event that damages one is not likely to prevent the other from performing its function.

SASO-A1-3.105 Isolate and recover from failures

The system must detect and isolate failures in safety-critical systems, and recover any total or partial lost (critical) function to continue safe operations.

SASO-A1-3.107 Structural design

The vehicle structure, including engines shall be designed to withstand the maximum loads expected in the operating environment throughout the operative life cycle of the vehicle, and have margin sufficient to account for design tolerances and uncertainties due to the environment, structural modelling, material properties, manufacturing processes and accidental damages.

SASO-A1-3.109 Propulsion system design

The propulsion systems or subsystems shall be capable to safely function within the operating environment throughout its whole operative life cycle of the vehicle, and have margin sufficient to account for design tolerances and uncertainties due to the environment.

SASO-A1-3.111 Aeroelastic stability

(a) The vehicle shall be free from static and dynamic aeroelastic instability:
  (1) At any combination of airspeeds and altitudes within and sufficiently beyond the expected operating environment where critical aeroelastic instability conditions may occur;
  (2) For any expected vehicle configuration and condition of operation
(b) Suitable tolerances shall be accounted for any vehicle characteristics that may affect aero elastic instability.

SASO-A1-3.113 Vibration

For any expected vehicle configuration and condition of operation, the vehicle shall be free from excessive vibrations within the operating environment and throughout its operative life.

SASO-A1-3.115 Electrical systems

The vehicle's electrical circuitry and electrical power distribution, including mating and de-mating of electrical connectors, should be designed to:

(a) Prevent electrical shock hazard to occupants;
(b) Fail safe;
(c) Prevent the generation of molten material;
(d) Prevent electrical wires from overheating; and
(e) Protect circuitry from floating debris.
(f) Provide Reliable insulation
(g) Prevent overheating of electrical devices

SASO-A1-3.116 Electromagnetic compatibility

The vehicle shall be designed to ensure electromagnetic compatibility between all equipment and subsystems within the vehicle and in the presence of its self–induced and external electromagnetic environment.

SASO-A1-3.117 Battery

(a) The battery shall be specified to ensure the energy balance in each mission phase during operational life, including contingency modes resulting from failures.

(b) The design of the battery and associated monitoring and control electronics shall preclude the occurrence of any of the following:

(1) Over-temperature (from battery thermal dissipation or environmental heating);

(2) Excessive currents (discharge or charge) including short–circuit (external or internal to the battery);

(3) Overcharging;

(4) Attempt to charge in the case of primary cells;

(5) Over discharge (including cell reversal);

(6) Cell leakage (gases or electrolyte).

SASO-A1-3.119 Lightning and static electricity protection

The vehicle shall be protected from the effects caused by lightning strikes and accumulation of electrostatic charge.

SASO-A1-3.121 Vehicle stability

A vehicle whose safe flight requires a specific attitude during one or more phases of flight, should be either inherently statically and dynamically stable in that orientation during that phase or phases, or controllable to a safe attitude.

SASO-A1-3.123 Material compatibility and hazards

(a) The vehicle shall be designed to ensure that materials are compatible and do not result in a hazard under the expected operating environment;

(b) For habitable volumes, the materials shall not cause a toxic atmosphere, act as an ignition source, cause an explosive or flammable gas, or generate particulates that could lead to serious injury or incapacitating illness.

SASO-A1-3.125 Natural and induced environments

Safety-critical systems shall be designed to operate in all expected natural and artificially induced environments.

SASO-A1-3.127 Collision prevention from orbital debris

The vehicle, when designed to operate at altitude above 150 km, should be designed to minimize the probability of a safety-critical damage, including penetration, by a micrometeoroid or non detectable orbital debris likely to be encountered during flight.

SASO-A1-3.129 Qualification testing

(a) The design of the vehicle's safety-critical systems shall be functionally demonstrated in a testing environment representative of the actual environment that the system will encounter in service with the sufficient margins to cover at least the required design safety factors.

(b) The test articles must be representative of the vehicle's configuration, materials and manufacturing processes for which the approval is sought.

(c) Test and measuring equipment to be used must be adequate to fulfil test procedure requirements and appropriately calibrated.

SASO-A1-3.131 Flight demonstration

(a) Prior to any flight with a flight participant, the integrated performance of a vehicle's hardware, software, and normal, abnormal and emergency operational procedures shall be demonstrated by successfully executing sufficient number of flights consistent with the design reference mission

(b) Further flight demonstration shall be conducted for any subsequent modification that needs flight testing to verify integrated system performance or when otherwise required by the Authority.

SASO-A1-3.133 Emergency communication with rescue personnel

The system shall be capable of communicating with an International Air Distress (IAD) frequency during an unforeseen and emergency situation.

In addition, the vehicle shall:

(a) Have a portable transmitter to provide occupant location to rescue personnel post-landing; and

(b) Be equipped with visual aids to assist rescue personnel.

SASO-A1-3.135 Security

Security (including cybersecurity) related aspects shall be taken into account in the design of the vehicle.

Chapter 4 - HUMAN / VEHICLE INTEGRATION

SASO-A1-4.100 Physical considerations

The vehicle shall be designed such that any operation requiring human interaction with the vehicle can be physically performed by flight crew or other occupants (trained and in case of lack of crew or incapacity), with the occupants, vehicle, and equipment in flight configuration consistent with the phase of flight in which such operation must be performed.

SASO-A1-4.101 Human Factor considerations

Human factor management of hazard shall be assessed using a structured analysis model whenever credit is taken for flight crew behaviour either in the classification or control of a hazard.

SASO-A1-4.103 System health, status, and data

For a safety-critical function allocated to the ground crew or remote operator, the system should provide the health, status, and engineering data necessary to perform the function. At a minimum, the remote operator or flight crew should be able to determine if a level of failure tolerance is lost in a safety-critical function.

SASO-A1-4.105 Manual override of automatic functions

Where automation is foreseen, the system should allow the flight crew or remote operator to manually override any automatic safety-critical function, provided the override of the function will not directly cause a catastrophic event.

SASO-A1-4.107 Detection and annunciation of faults and failures

The system shall detect and annunciate vehicle system failures and detectable faults to the flight crew, within the time necessary for the flight crew to take any action necessary to address the consequences of the fault.

SASO-A1-4.109 Voice communication with the vehicle

The vehicle system and the associated supporting infrastructure shall provide two-way voice communication between the occupants, and the ground crew that carry out safety critical functions, from pre-launch through post-landing occupant egress.

SASO-A1-4.111 Occupants communication

The vehicle shall be designed such that:

(a) occupants with a safety-critical role can communicate orally with each other during safety-critical operations;

(b) flight crew can communicate orally with other occupants.

SASO-A1-4.113 Flight crew compartment

(a) Under any anticipated operating conditions:

(1) The flight crew compartment arrangement and the installed equipment intended for flight crew use shall allow the flight crew to perform their duties, without excessive concentration, skill, alertness, or fatigue,

(2) For operation requiring an external view by the flight crew, the vehicle shall provide a window with a direct, non-electronic, through-the-hull view and the unobstructed field-of- view.

(b) The controls and displays shall be installed so that a qualified flight crew can monitor and perform the defined tasks associated with the intended functions of systems and equipment.

(c) To the extent practicable the installed equipment shall enable the flight crew to manage reasonable human errors that can be expected from the interaction of the flight crew with the equipment.

SASO-A1-4.115 Inadvertent actions

No single inadvertent occupant or crew action shall result in an event causing serious injuries to occupants.

SASO-A1-4.117 Flight crew loads

Vehicle systems (e.g. switches, knobs, handles) shall be designed to withstand intentional and unintentional occupants generated loads without losing or degrading their functions.

SASO-A1-4.119 Instrumentation displays

Instrumentation shall display information that is readable in the environment of intended use. Instrumentation shall display safety-critical information that is readable under any anticipated operating conditions.

SASO-A1-4.123 Control of glare and reflection

Glare and reflection on windows and displays shall not interfere with flight crew performance of operations.

SASO-A1-4.125 Handling qualities

The vehicle shall be controllable to the extent necessary to allow the flight crew to perform their operations.

SASO-A1-4.127 Workload

The crew and the ground controllers shall be able to perform any critical operation for the safety taking into account the expected physical and cognitive workload.

SASO-A1-4.129 Emergency control markings

Vehicle emergency controls shall be clearly marked and distinguishable from non-emergency controls.

SASO-A1-4.131 Emergency equipment access

The vehicle shall be designed such that the flight crew can access to the equipment involved in the response to an emergency situation within the time required to respond to the hazard.

SASO-A1-4.133 Emergency lighting

The vehicle shall be provided with:

(a) Emergency lighting for occupant egress and operational recovery in the event of a general power failure which includes unpowered illumination sources that provide markers or orientation cues; and

(b) A flashlight, or other personal lighting device, for each flight crew member, readily available at all times.

SASO-A1-4.135 Emergency vehicle egress

The vehicle shall be designed to:

(a) Allow occupants to visually determine hazards outside the vehicle on the primary egress path without the use of vehicle electrical power;

(b) Allow the manual mechanical opening (hatch) of the egress be operated without the use of tools, in any probable attitude of the vehicle that may result from the emergency, from the inside by a single occupant, and from the outside by ground personnel and rescue personnel;

(c) Allow all occupants to physically egress within the time required to avoid a serious injury in the event of an emergency on the ground; and

(d) Provide for unassisted egress of the occupants.

Chapter 5 – SYSTEM SAFETY

SASO-A1-5.101 System safety engineering

A system safety engineering process should be implemented at the beginning of the development cycle of the system to identify and characterize each hazard, assess the risk to occupants, reduce risks through the use of risk elimination and mitigation measures, and verify that risks have been reduced to an acceptable level. Hazard analyses should be continuously updated throughout the life cycle of the system. The process shall:

(a) Identify and describe hazards and the associated causes, including those that result from:

(1) Component, subsystem, or system failures or faults;

(2) Software errors and operations;

(3) Environmental conditions;

(4) Human errors;

(5) Design inadequacies;

(6) Procedural deficiencies;

(7) Incompatible materials;

(8) Functional and physical interfaces;

(9) Biological sources; and

(10) Interactions of any of the above.

(b) Identify and describe each safety-critical system and its function.

(c) Identify and describe all safety-critical events.

(d) Implement a hazard control strategy that will prevent the occurrence of the hazard, or mitigate the risk to an acceptable level. These hazard controls should include one or more of the following:

(1) Failure tolerance

(2) Sufficient design margins;

(3) Operating and emergency response procedures

(4) An environmental qualification and acceptance testing program

(5) Training or certification

(6) Operational constraints

(7) Monitoring of safety-critical systems

(e) Demonstrate that the hazard controls and risk mitigation measures have been successfully Implemented through objective verification evidence. Verification should include one or more of the following:

(1) Test data;

(2) Inspection results

(3) Analysis

(4) Demonstration.

SASO-A1-5.103 Software safety engineering

(a) Hazards from computing systems and software should be integrated into the safety engineering process as outlined under **SASO-A1-5.101**

(b) Computing systems and software functions should be considered safety-critical if they:

(1) Are used to control or monitor safety-critical systems;

(2) Transmit safety-critical data, including time-critical data and data about hazards;

(3) Are used for fault detection in safety-critical computer hardware or software;

(4) Respond to the detection of a safety-critical fault;

(5) Compute safety-critical data;

(6) Access safety-critical data;

(7) Are used to model or simulate safety-critical parameters or functions; and

(8) Share hardware resources with safety-critical data, or share command pathways with safety-critical data.

(c) A software development process and maintenance approach shall be documented and maintained. The process should, at a minimum, include:

(1) Software development methods and standards;

(2) Software design (i.e., architecture, components, modules, interfaces, and data);

(3) Approach to analyse and certify off-the-shelf software.

SASO-A1-5.105 Critical items

Critical Items which are a potential threat to the safety shall be controlled by a specific action plan, Including a process that provides configuration control over safety-critical items design, manufacturing, and operations throughout the system's life.

Chapter 6 – OCCUPANT SURVIVABILITY ANALYSIS

SASO-A1-6.101 Occupants survivability analysis

An analysis shall be conducted to identify what additional equipment or capability, in a catastrophic event, might provide the occupants with an increased chance of survival.

Chapter 7 – DESIGN DOCUMENTATION

SASO-A1-7.101 Operational documentation

Documentation shall be developed and kept current that describes how to operate and maintain the vehicle within the limitations and capabilities of the vehicle itself. At a minimum, this documentation should include the following items:

(a) Vehicle and operations overview;

(b) Vehicle systems descriptions (hardware and software), functions, and associated hazards;

(c) Performance and flight qualities;

(d) Mass properties;

(e) System limitations;

(f) Consumable limitations;

(g) Physical and anthropometric limitations on the flight crew or flight participants;

(h) Weather limitations;

(i) Landing site limitations;

(j) Normal procedures;

(k) Emergency procedures;

(l) Crash, fire, and rescue procedures;

(m) Software and computing system user procedures, operating limitations, and known problems; and

(n) Maintenance requirements for hardware and software to ensure continued flightworthiness.