Order of March 31st, 2011 concerning the technical regulation implementing Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations

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The Minister for higher education and research,

Having regard to the Directive 98/34/EC of the European Parliament and European Council of June 22nd, 1998 laying down a procedure for the provision of information in the field of technical standards and regulations and rules concerning the services of the information society, in particular notification n° 2010/0687/F;

Having regard to the research code, in particular Chapter 1 of Title III of Book III;

Having regard to Act no. 2008-518 of June 3rd, 2008 relating to space operations, as amended;

Having regard to Decree no. 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to the Act of June 3rd, 2008 relating to space operations, in particular its Article 1,

Orders:

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PART ONE: DEFINITIONS AND PRELIMINARY PROVISIONS

Article 1 - Definitions.

For the purpose of this Order, in addition to the terms defined in Article 1 of the Act of June 3rd, 2008 relating to space operations above-mentioned, the following definitions are adopted:

“Allocation”: level of probability given to the occurrence of a critical or specified event, when establishing the safety objectives;

“Catastrophic damage”: immediate or deferred loss of human life, or serious injury to human beings (irreversible health impairments, permanent disabilities or occupational invalidity or illness).

“Constellation”: group of space objects consisting of at least ten space objects working together for a common mission, with a predefined orbital deployment plan. Also refer to Mega-constellations;

“Controlled re-entry”: atmospheric re-entry of a space object with a predicted Earth contact or impact zone for the object or fragments thereof. A controlled re-entry may be a precision re-entry on a site, or by targeting a limited area with a certain level of confidence.

Note:

• Examples of precise re-entry on a site: reusable launcher stages, space objects, etc.

• Example of re-entry targeting a limited area with a certain level of confidence: controlled re-entry of orbital stages of consumable launchers, etc.

“Disposal phase”: final phase of the space operation during which safety actions are taken on the space object in order to limit risks related to space debris;

“Dispenser”: Device that carries one or several space objects for a multiple launch and injects them into the orbits required by the customer(s). Such a device, with or without propulsion, which releases one or more space objects after its separation from the launcher, is subject to the orbital requirements specified in Part III of this Order;
Note: A device without propulsion which releases space objects without separation or before separation from the launcher is covered by the requirements for launcher components specified in Part II of this Order.

“End of life”: end of the disposal phase of the space object or loss of control of it;

“Flight corridor”: volume within which the launch or re-entry vehicle is expected to travel, taking normal dispersion into account;

“Irreversible moment”: for a launch operation, the instant at which the command is sent leading irrevocably to the lift-off of the launch vehicle;

“Launch vehicle”: assembly comprising the launcher and the space objects intended to be placed into orbit;

“Launcher”: self-propelled vehicle designed to place space objects into orbit;

“Mega-constellation”: constellation containing at least one hundred space objects;

“Neutralisation”: action taken on the launcher or the re-entry vehicle in order to minimise damage to persons and property. It can in particular be characterised by an action capable of destroying or halting the thrust of a

launch or re-entry vehicle, in order to terminate the flight of said vehicle or of a stage which is no longer functioning correctly;

“Nominal”: corresponding to the specifications or performance levels announced by the operator or designer of the space object;

“On-board neutralisation device”: on-board systems involved in neutralising the launch or re-entry vehicle in flight;
Note: The on-board neutralisation device may be remote-controlled from an external or independent means.

“On-orbit servicing (OOS)”: service performed by a servicing vehicle and which requires a rendezvous and/or approach and/or contact phase with a target object, such as: inspection, capture, docking, on-orbit transfer, repair, assembly, fluids transfer, undocking. The following definitions therefore apply:

- “Approach phase”: Series of orbital manoeuvres performed in the Proximity Zone to position and keep a vehicle in the immediate vicinity of the target object, according to a planned and predetermined trajectory, for the duration required by the mission.
- “Attached phase”: Phase during which the two objects make up the composite.
- “Capture”: Action of establishing a physical connection between two space objects.
- “Composite”: Assembly consisting of the servicing vehicle and the target object after Capture.
- “Contact phase”: Phase consisting of the following three steps:
    - o Final movement of the servicing vehicle to the target object beyond the point of no return and up to contact
    - o Capture of the target object,
    - o Stabilisation of the composite.
- “Corridor”: volume within which the servicing vehicle is expected to travel taking normal dispersion into account;
- “Parking point”: Waiting zone outside the proximity zone, designed to maintain a constant relative distance from the target object while the servicing vehicle is waiting prior to initiating the manoeuvres bringing it into the proximity zone.
- “Point of no return”: Moment during the approach phase after which all abort manoeuvres are impossible.
- “Proximity zone”: Volume around the target object in which a series of orbital manoeuvres dictated by the relative positions, speeds and attitudes of the two objects, enables the servicing vehicle to be placed in and kept in the immediate vicinity of the target object.
- “Rendezvous phase”: Phase during which two space objects are intentionally brought into the proximity zone by means of a series of orbital manoeuvres at a predetermined and scheduled time and place.
- “Separation and distancing phase”: Series of manoeuvres ensuring physical separation of the target object and the servicing vehicle, and the distancing of the servicing vehicle beyond the proximity zone.
- “Servicing vehicle operator”: Entity which carries out the on-orbit servicing activities.
- “Servicing vehicle”: Space object which performs the on-orbit servicing operations.
- “Target object”: Space object (including space debris) served by the servicing vehicle.

“Operational phase”: period of time which, during an operation involving control in outer space, begins at the moment the operator takes control of the space object or the group of coordinated space objects and ends with the beginning of the disposal phase;

“Protected regions”:

1. Protected region A, low Earth orbit (LEO) – spherical region extending from the surface of the Earth up to an altitude of 2,000 km;

2. Protected region B, geosynchronous region – segment of the spherical envelope defined as follows:

- lower limit = geostationary altitude minus 200 km;
- upper limit = geostationary altitude plus 200 km;
- latitude between - 15 and + 15 degrees;
- geostationary altitude (GEO) = 35786 km (altitude of geostationary Earth orbit);

“Recovery phase”: During the launch phase, phase beginning with the separation of the reusable element of the main launcher and ending with the immobilisation of this element on Earth;

“Re-entry vehicle”: Space object, which is not part of a launch vehicle, designed to land on Earth intact after an orbital or suborbital flight phase.

“Reusable launcher”: launcher, of which some or all of the elements are recovered on Earth for reuse during a subsequent launch operation;

“Safety coefficient”: ratio between the allowable limit of a parameter characterising a system or an element and its maximum expected value in nominal operation. Its value includes the notion of dispersion specific to each field concerned;

“Safety”: set of requirements intended to control risks in order to ensure protection of individuals, property and public health and the environment;

“Safety margin”: margin between the allowable limit of a parameter characterising a system or an element and its maximum value reached in normal operation, multiplied by the safety coefficient;

“Space debris”: any non-functional space object of human origin, including fragments and parts thereof, in Earth orbit or re-entering the Earth's atmosphere;

“Space object”: any object of human origin which may or may not be functional during its launch, its time spent in outer space or its return, including the elements of a launcher placed into orbit;

“Space object mission”: means, for each space object, all the tasks or functions performed during the operational phase of the operation of controlling such object.

“Space system”: system comprising one or more space objects and the equipment and installations associated with them in order to perform a specified mission.
In the case of a launch operation, the space system comprises the launcher, the relevant launch base, including tracking systems (networks of ground stations and satellites), and the space object or space objects to be launched;
In the case of a control operation, the space system comprises the space object or space objects and the interfaced ground segment;

“Stage”: Launcher element, whether or not with propulsion, designed to detach after its primary mission;
Note 1: an orbital stage corresponds to a stage separated in orbit. Note 2: a fairing is considered to be a stage.

“Technical risk”: risk of technological, industrial, operational, human or natural origin. Expression used to differentiate the technical risk from all other types of risks, especially financial or linked to installations security;

“Uncontrolled re-entry”: atmospheric re-entry of a space object for which it is not possible to predict the Earth impact zone for the object or fragments thereof.

Article 2 - Preliminary provisions.

1. The purpose of this Order is to specify the technical regulation on the basis of which the minister with responsibility for space, following a check on conformity by the Centre national d'études spatiales (CNES), grants an authorisation to carry out a space operation, pursuant to the above-mentioned Act of June 3rd, 2008.

2. The provisions of this Order apply to the space operations mentioned in Articles 2 and 3 of the above-mentioned Act of June 3rd, 2008, except those for which the conformity verification is waived in the conditions of paragraph 4 of Article 4 of the above-mentioned Act.

3. The provisions of this Order apply only:

a) To a launch operation of a launch vehicle which meets all of the following three criteria:

- lift-off from the ground;
- rocket propulsion;
- unmanned flight;

b) To an operation to control an unmanned space object or unmanned group of coordinated space objects in outer space;

c) To an operation to return an unmanned space object to Earth.

The technical regulation applicable to the space operations not mentioned above, will be the subject of a specific Order.

4. Compliance with the requirements of this Order may in no way relieve the operator of its liability for any damage caused to third parties, as specified in Article 13 of the above-mentioned Act of June 3rd, 2008.

5. Personnel who, pursuant to Article 7 of the above-mentioned Act of June 3rd, 2008, are empowered to check compliance with the technical requirements stipulated with reference to this technical regulation and appended to the licensing Order, are placed under the authority of the President of the CNES in the conditions stipulated in the Order so empowering them.

PART TWO: LAUNCH OF A SPACE OBJECT AND RETURN OF LAUNCHER ELEMENTS TO EARTH

TITLE I: SCOPE

Article 3

The provisions of this part apply to the launch operation, up until the end-of-life of the stages and launcher elements, or up until their recovery, as applicable.

TITLE II: TECHNICAL FILE

CHAPTER I: REQUIRED DOCUMENTATION (REPEALED)

Article 4 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 5 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 6 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 7 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 8 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 9 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Article 10 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 3

Amended by Order of July 11th, 2017 - Art. 3

CHAPTER II: QUALITY SYSTEM REQUIREMENTS

Article 11 - Quality assurance.

1. For performance of the space operation, the launch operator shall implement and manage a quality management system as well as internal standards and quality management requirements. This management system shall cover quality assurance, RAMS (reliability, availability, maintainability, safety), configuration management and steering of works.
2. The space system shall be designed, produced, integrated and implemented in such a way as to control the hazards induced by the critical activities. An activity is said to be critical if a human error or failure of the resources employed increases the risk of human injury during the launch operation.
3. A system for monitoring and controlling any drift in manufacturing and implementation shall be installed. This system should allow traceability of technical and organisational events affecting engineering and production activities.
4. The quality management system in particular shall deal with the following technical or organisational events:
   - deviations (anomalies, evolutions) in relation to the configuration (definition, launch system production and implementation process) which was granted the authorisation or, as applicable, the licence;

- deviations (anomalies, evolutions) resulting from assessment of parameters recorded in-flight, likely to compromise the conditions in which the authorisation or, as applicable, the licence, was granted.

5. The description and justification of launcher behaviour, and the definition of the materials used, shall be retained until the end of the space operation concerned. Following it, these elements shall be transmitted to the CNES with the description of the state reached.

Article 12 - Competence, resources, organisation and installations.

The launch operator shall have the competence, resources and organisation necessary for preparing and implementing the planned launch operation:

- appropriate installations and organisation;
- equipment and tools appropriate to the planned operation;
- documentation concerning tasks and procedures;
- access to data of use for preparation of the planned operation;
- recording, processing and archival of technical data;
- key posts and associated training process.

Article 13 - Technical and organisational events.

The launch operator shall set up an organisation enabling it, in compliance with article 7 of the above-mentioned Decree of June 9th, 2009 and without delay, to inform the CNES of any technical or organisational events as mentioned in the 4th paragraph of Article 11 of this Order as well as the progress of their processing up until closure.

Article 14 - Technical reviews.

1. Technical reviews to check implementation of the provisions of this Order shall be scheduled by the launch operator. These reviews can also be carried out as a part of reviews conducted elsewhere, as part of the development and exploitation activities.

2. The launch operator shall inform the CNES of the performance of the reviews prior to launch. The personnel empowered in compliance with Article 7 of the above-mentioned Act of June 3rd, 2008 may attend them in the conditions defined by this same article.

Article 15 - Co-contractors, sub-contractors and customers.

1. The launch operator shall ensure that its co-contractors, subcontractors and customers apply all the provisions required for establishing and maintaining conformity with this technical regulation.

2. The launch operator shall, under its own responsibility, ensure that the above-mentioned persons apply provisions relating to organisation, quality assurance and engineering as stipulated by the standards and practices recognised by the profession.

3. In the event that the launch operator is a legal entity other than the launcher supplier, the launch operator shall, under its own responsibility, ensure that the provisions set out in Articles 11 and 12 of this Order are applied to the launcher supplier.

4. The launch operator shall, under its own responsibility, ensure that its customers apply the provisions such as to guarantee compatibility (geometrical, mechanical, dynamic, thermal, electromagnetic and radio electric) between the space objects to be placed into orbit and the launch system, and shall check that this has been taken into account.

CHAPTER III: SPECIFIC TECHNICAL REQUIREMENTS FOR THE LAUNCH OPERATIONS

SECTION 1: GENERAL TECHNICAL REQUIREMENTS LINKED TO THE LAUNCH OPERATION

Article 16 - Required proof

1. To ensure technical control of the system and procedures with respect to the critical events mentioned in Article 7 of the Order of February 23rd, 2022 concerning the composition of the files mentioned in Article 1 of Decree

2009-643 of June 9th, 2009 concerning licenses issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended, the launch operator shall comply with the following provisions:

a) use a technical standards framework;
b) take into consideration the climatic environment in which the system is operated;
c) ensure the ability of the launch system and its subsystems to perform the mission, taking account of:
- the description, the sizing;
- the tests and/or modelling, readjustment and precision of the associated models, which shall highlight the interfaces and interactions between the different subsystems and between the different disciplines;
- the safety coefficients and safety margins;
- the parameters of the ground segment interfacing with the launcher (surveillance thresholds);

d) ensure the management and reproducibility, as necessary, of the industrial manufacturing, inspection and implementation processes.
e) incorporate RAMS analyses into the design, including reliability assessments and identification of critical points;
f) as applicable, take account of a post-flight revalidation plan for the reusable launcher elements;
g) take account of measures resulting from the launch system hazard analyses and operational hazard analyses;
h) take account of experience feedback from processing of technical events during development, production, testing and flight;
i) draw up scenarios for fragmentation and generation of space debris at re-entry or neutralisation of the launch vehicle.

2. Compliance with the provisions set out in 1 of this Article shall be guaranteed in each of the following cases:

- flight envelope (nominal case, case with uncertainties associated with dispersion and lack of data), where appropriate;
- extreme envelope;
- non-nominal cases (failures).

Said proof shall cover:
- all system life phases, including the recovery phase where appropriate;
- all stabilised and transitional phases encountered.

3. For the implementation of the provisions set out in 1 of this Article, the operator:

a) Characterises the launch vehicle nominal and extreme movements envelope (free movement with six degrees of freedom of the launch vehicle);

b) Evaluates launcher reliability within this envelope, in particular with regard to:

- its mechanical strength (propulsion systems, main structures and subsystem);
- the performance of the propulsion and pyrotechnical systems;
- the performance of the flight control systems (in particular electrical and hydraulic systems and software);
- as required, the reliability of the on-board neutralisation system and its effect on the fall-back areas.

c) Determines:

- the minimum value in terms of incidence and dynamic pressure guaranteeing structural break-up;
- fragmentation (number of debris pieces, geometry, mass, characteristics of materials) of all or part of the launch vehicle, depending on the mechanical or thermal origin of the destruction scenarios.

d) With regard to the implementation operations linked to launch preparation:

- analyses the risks associated with the chronology of the launch operation, to guarantee that the expected status is reached at the irreversible moment;
- ensures the harmlessness of the preparation operations for the reliability of the launch vehicle during the launch operations, based on an analysis of all the manufacturing, integration and inspection processes carried out directly by humans or remotely via an instrumentation and control system.

4. For a reusable Launcher element, provisions 1 to 3 of this Article shall cover its complete lifecycle.

Article 17 - Specific mission analysis.

For the specific launch operation envisaged, and in addition to the provisions required by Article 16 of this Order, relating to the generic definition of the launch system for a given mission family, the operator:

1° Ensures compliance with the operating envelope of the launch vehicle;

2° Ensures the compatibility of the objects intended to be placed into orbit with the launcher environments (geometrical, mechanical, dynamic, thermal, electromagnetic, and radio electric);

3° Determines the load levels on the launch vehicle, including the space objects intended to be launched (dynamic and thermal loads);

4° Ensures the compatibility of the payload separation systems with the environments of the launch vehicle;

5° As applicable, for a reusable Launcher element, ensures compliance with the post-flight revalidation plan mentioned in 1 of Article 16 of this Order, with a view to its reuse;

6° Ensures the conformity of the actual characteristics of the specific launcher used for the mission with the theoretical definition presented in compliance with Article 16 of this Order;

7° As applicable, ensures that any deviations (anomalies, evolutions) in relation to the qualified configuration, in accordance with the requirements of Article 16 of this Order (definition, production process, implementation and, as applicable, post-flight revalidation) and those resulting from assessment of the parameters recorded in-flight, are analysed and made technically acceptable;

8° Ensures the acceptability of the specific mission trajectory, optimised with respect to the potential hazards;

9° Ensures that there is no risk of collision between the launcher and its satellites and between the satellites themselves until they become manageable or, at the most, for the five days following the end of the launch vehicle disposal phase;

10° Defines a flight corridor around the nominal trajectory, up to orbital injection or until the end of the on-site recovery phase for the reusable launcher elements;

11° Determines the sizing and position of the fall-back zones for the elements not placed into orbit, including with regard to notification of air and maritime traffic;

12° Defines the end-of-life choices for the elements placed into orbit in compliance with the requirements of Article 20 and paragraphs 4, 5, 6 and 7 of Article 21 of this Order and, as applicable, determination of the fall-back zones;

13° Ensures the validity of the customized parameters for flight control and the flight software, tailored to the mission, such as to guarantee the correct working of the flight software;

14° As applicable, for the launch vehicle on-board neutralisation systems and, as applicable, the reusable stages:

- defines the settings based on analysis of simulated trajectories, including non-nominal cases;
- determines the sizing and positioning of the debris fall-back zones following neutralisation;
- ensures the validity of the flight software specific algorithm thresholds triggering neutralisation of the launch vehicle and, as applicable, the reusable stages, in order to demonstrate correct operation.

Article 18 - On-board neutralisation systems.

For the launch phase:

The launch operator shall identify the failure scenarios at the origin of abnormal situations leading the launch vehicle to become a hazard, in particular in the following cases:

- deviation from the predetermined flight corridor;
- dangerous fall-back and recovery phase for those elements designed to detach;
- non-nominal behaviour of flight control;
- failure to place the upper composite into orbit.

The operator shall quantitatively and qualitatively deduce the need or otherwise for on-board systems allowing neutralisation of the launch vehicle before the moment at which the impact zone is, in full or in part, within a territory placed under the sovereignty of any State encountered along its nominal trajectory, including its territorial waters. If such systems prove to be necessary, the operator must have their definition and settings as required by Article 17-14 of this Order.

Neutralisation of the launch vehicle may be triggered by sending a remote-controlled order or automatically by means of an autonomous flight safety system. In this second case, the definition data and the results of the validation tests, including the demonstration of the correct working of the autonomous flight safety system in all non-nominal flight cases, shall be communicated to the CNES.

If an autonomous flight termination system is carried, a preliminary conformity file as set out in 1 of Article 11 of the above-mentioned Decree of June 9th, 2009 and part four of this Order, shall be submitted to the CNES.

For controlled re-entry:

The launch operator shall identify the failure scenarios at the origin of abnormal situations leading to the propulsion element of the launcher placed into orbit becoming a hazard, in particular in the case of failure to control the level or direction of thrust.

The operator shall define the on-board automatic systems and corresponding criteria for ensuring controlled re-entry of the propulsion element placed into orbit, while complying with the objectives of Articles 20 to 23 of this Order.

Article 19 - Flight tracking, major anomaly in flight and associated experience feedback.

1. The launcher operating parameters, including its positions and speeds, which have an impact on risk management as resulting from the hazards study and the impact assessment mentioned in Articles 7 and 8 of the Order of February 23rd, 2022 concerning the composition of the files mentioned in Article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended, shall be acquired, transmitted to the ground, recorded and analysed by the launch operator. Any deviation of these parameters from the expected reference state constitutes a technical event which shall be subsequently analysed for any recurring launch system.

2. In the case of a major in-flight anomaly calling into question the hazards study and associated risk reduction actions, the launch operator shall hold a board of inquiry, to analyse the causes of the anomaly encountered and

identify the corrective measures to be implemented in order to allow a return to flight, involving experts from the CNES.

Following the board of inquiry and prior to the return to flight, the launch operator shall provide to the CNES, in particular to the relevant CNES personnel authorised under Article 7 of the above-mentioned Act of June 3rd, 2008:

- the results of the investigations performed;
- the recommendations made by the board of inquiry and the resulting action plan;

And shall then provide the following documents:

- the board of inquiry report;
- justifications demonstrating that the recommendations made by the board of inquiry have been taken into account;
- as applicable, the updated documents as per Articles 4 to 10 of the Order of February 23rd, 2022 mentioned in paragraph 1 of this article.

SECTION 2: QUANTITATIVE OBJECTIVES FOR HUMAN SAFETY

Article 20 - Quantitative objectives for human safety.

1. For the cumulative catastrophic damage risks, the launch operator shall meet the following quantitative objectives, expressed as a maximum allowable probability of causing at least one casualty (collective risk):

a) Launch risk (excluding the reusable launch elements recovery phase):

$2* 10^{-5}$ for the entire flight phase between lift-off and satellisation of the launch vehicle, including consideration of degraded launch system situations and fall-back of elements designed to separate from the launcher without being placed into orbit;

10^{-7} by nominal fall-back of those elements designed to separate from the launcher without being placed into orbit, in accordance with paragraph 1 of Article 23 of this Order.

b) Re-entry risk (excluding the reusable launch elements recovery phase):

$2* 10^{-5}$ for the phase between satellisation of the launch vehicle and return to Earth by each launcher element placed into orbit as part of a controlled atmospheric re-entry, including, in accordance with paragraph 1 of Article 23 of this Order, a specific allocation of 10^{-7} for the nominal return of each element. The launch operator implements this controlled re-entry in accordance with 1 and 5 of Article 21 of this Order.

In the exceptional case, with due justification, in which the operator is unable to proceed with a controlled atmospheric re-entry as mentioned in paragraph 5 of Article 21, the launch operator shall use its best efforts to meet a quantitative objective of 10^{-4} for the return phase of each launcher element placed into orbit. In this case, the choice of the architecture and materials of the elements placed into orbit and subject to uncontrolled re-entry shall be dictated by the objective of limiting the number and energy (kinetic and explosive) of the fragments liable to reach the ground.

c) Risk for the recovery phase of reusable launcher elements:

$2*10^{-5}$ for the recovery phase of each launcher element designed to be reused.

In the case of an orbited reusable stage, the launch operator implements controlled re-entry to the site in accordance with 1 and 5 of Article 21, and 2 of Article 23 of this Order.

In the case of a non-orbited reusable stage, the launch operator implements the on-site recovery phase in accordance with 2 of Article 23 of this Order.

2. The requirements mentioned in 1 of this Article shall be evaluated using a calculation method taking account of:

- all the phenomena leading to a risk of catastrophic damage (ascent phase, stage fall-back after separation, atmospheric re-entry of a stage placed into orbit, reusable stage recovery phase);
- the trajectories before fragmentation (atmospheric or extra-atmospheric), depending on the flight times and failures considered;
- the scenarios for fragmentation and generation of the corresponding debris, at neutralisation of the launch vehicle and on return to Earth by any Launcher element;
- dispersion of debris on the ground and evaluation of their effects;
- launcher reliability for the launch phase, including during the recovery phase as applicable;
- the reliability of the de-orbiting manoeuvre for the launcher element placed into orbit, in the case of controlled re-entry;

3. Specific quantitative allocations for a risk of particular catastrophic damage may be prescribed, notably for the specific cases of maritime and air routes, in accordance with article 5 of the above-mentioned Decree of June 9th, 2009.

SECTION 3: LIMITATION OF SPACE DEBRIS AND PREVENTION OF COLLISION RISKS

Article 21- Limitation of space debris.

The launch vehicle implemented by the launch operator shall be designed, produced and implemented such as to comply with the following requirements for the elements operating in outer space:

1. The launcher shall be designed, produced and implemented in such a way as to minimise the production of debris during nominal operations, including after the end-of-life of the launcher and its component parts. The launch operator in particular shall take the following measures in this respect:

- for launch of a single space object, a single launcher element (for example a stage) may be placed into orbit;
- for launch of several space objects, a maximum of two launcher elements (for example a stage or the adapter structure) may be placed into orbit.

The above provisions do not apply:

- to the pyrotechnic systems. However, these shall not generate products with the largest dimension of 1 mm or more;
- to solid or hybrid propellant boosters. They should not however generate combustion debris of 1 mm or larger in protected regions A and B.

2. The launcher shall be designed, produced and implemented so that the debris produced in compliance with the requirements of the first paragraph above and which do manage to reach the surface of the Earth, constitute no excessive risk for individuals, property, public health or the environment, in particular as a result of environmental pollution by hazardous substances.

3. The probability of occurrence of accidental break-up shall be less than 10^{-3} until the end-of-life of the orbited launcher element(s); its calculation shall include failure modes of propulsion and power systems, mechanisms and structures, the passivation operations described in 4 of this Article, but shall not take account of any external impacts.

If an orbited stage of the launcher cannot make a controlled re-entry as planned, it shall be passivated in a safe and controlled manner.

4. The launcher shall be designed, produced and implemented so that, following the disposal phase, all of its elements are passivated:

- all the on-board energy reserves are permanently depleted or placed in a state such that their depletion is inevitable, or in a state such that they entail no risk of generating debris;
- all on-board energy production means are permanently deactivated, or all the equipment directly supplied by these energy production means are placed in a state such that they entail no risk of generating debris.
- following the disposal phase, the launcher shall be in a stable state with minimal internal energy.

5. Region A protection

The launcher shall be designed, produced and implemented so that, after the end of the launch phase, its components placed into orbits passing through protected region A are de-orbited by controlled atmospheric re-entry.

In the exceptional case, with due justification, that this provision is not complied with, the launcher shall be designed, produced and implemented so that its components are no longer present in protected region A twenty-five years after the end of the launch phase. This result shall be obtained by uncontrolled atmospheric re-entry. The launch operator shall also demonstrate that it employs the means required to minimise the time in orbit of the component parts of the launcher passing through protected region A to 25 years at the most after disposal.

6. Region B protection

The launcher shall be designed, produced and implemented so that, after the end of the launch phase, its components stationed in an orbit, in or passing through protected region B, are placed in an orbit which does not interfere with this region for more than one year. This orbit shall be such that, under the effect of natural disturbances, the launcher or its orbited components do not return to protected region B within one hundred years following the end of the disposal phase.

If the eccentricity of the target orbit for the component parts of the launcher after the disposal manoeuvres is greater than 0.25, it shall enable compliance with the requirements stipulated in point 6 a) of this article with a probability of at least 0.9 taking account of the effect of natural orbital disturbances and the related uncertainties.

7. Specific case of missions to Lagrange points or with an escape orbit.

The launch operator shall use all necessary means to ensure that the component parts of the launcher do not return either to protected region B, or to protected region A, within one hundred years following the end of the disposal phase. For this purpose, the operator shall take all necessary steps for the launcher to implement an escape manoeuvre or generate a speed increment. In addition, the non-intersection of protected regions shall be demonstrated utilising state-of-the-art orbital calculation methods.

8. The probability of successfully completing the disposal operations mentioned in paragraphs 4.5, 6 and 7 of this Article shall be at least 0.9. This probability is evaluated for the total duration of the operation. Its calculation, carried out before the beginning of the space operation, shall take account of all the systems, subsystems and equipment usable for these operations, their redundancy levels as applicable and their reliability, taking account of the effects of the ageing reached at the time at which performance of these operations is scheduled, along with the availability of the means and energy resources necessary for these operations.

9. Intentional fragmentations of launcher elements are prohibited.

Paragraph 3 should read as 10^{-3} instead of 10^{3}.

In accordance with Article 20 of the Order of February 23rd, 2022 (NOR: ECOJ2206379A), these provisions come into force on 1 January 2023.

Article 22 - Prevention of collision risks.

The systems shall be designed, produced and implemented and their mission defined so that, during the space operation and for three days following the end of the disposal phase, the risks of accidental collision between the launcher elements, including the injected satellites and manned objects for which the orbital parameters are accurately known and available are limited.

SECTION 4: REQUIREMENTS RELATED TO FALL-BACK TO EARTH AND THE RECOVERY OF REUSABLE LAUNCHER ELEMENTS

Article 23 - Prevention of risks arising from fall-back by the launcher or fragments thereof.

1. If the launcher comprises elements designed to separate during the launch phase, or in the case of launcher elements placed into orbit subject to controlled atmospheric re-entry, the fall-back zone on Earth shall be controlled by the launch operator. The fall-back zone, associated with a probability of 99.999%, shall not impinge on the territory, including the territorial sea, of any State, without its agreement.

The launch operator thus implements the following measures:

- takes account of the trajectories before fragmentation (atmospheric or extra-atmospheric), depending on the moments of stage separation and taking account of dispersion of the operation of the launch vehicle subsystems
- modelling of the scenarios covering fragmentation and the corresponding generation of debris;
- analysis of dispersion of the debris falling into the sea.

2. If the launcher comprises elements which are to return to a site, the launch operator shall comply with the applicable regulations specific to the said site.

In the case of an operation to return to a site other than the French Guiana Space Centre (CSG), the operator shall provide the information required by the second paragraph of Article 27 of this Order.

In the specific case of a return by launcher elements to an offshore landing site (for example a barge or ship), the fall-back region Associated with a probability of 99.999% shall not impinge on the territory of any State. In the event of any impingement on the territorial sea of a State, the latter’s approval shall be obtained.

3. In the event of a fall-back zone being situated in a region with heavy maritime or air traffic, or in which manned oil platforms are located, a special analysis shall be carried out to deal with the hazards described in article 7 of the Order of February 23rd, 2022 concerning the composition of the files mentioned in article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended.

4. The organisation and resources put into place by the launch operator shall enable the Chairman of the CNES, in conjunction with the authorities of the launch site and/or the return site:

- to inform the competent authorities in charge of air and maritime traffic control of the fall-back zones in a nominal situation, specifying the zones receiving 99% of these fall-backs;

- in any non-nominal situation, to transmit without delay to the competent authorities the information concerning the fall-back zone of elements, so that the authorities of the states concerned can be warned as early as possible.
- to provide all useful information so that the necessary response plans can be determined and implemented by the competent authorities.

Article 24 - Floating objects, wrecks and recovery of launcher elements.

1. All launchers shall be designed, produced and implemented so that the propulsion stages designed to fall back to Earth do not constitute a hazard following the creation of a floating object or a maritime wreck. Wrecks and floating objects shall not constitute an obstacle or hazard for navigation, fishing, or the environment, nor a hazard or obstacle in a port, approach channel or road, nor a lasting hazard on the maritime coastline.

2. When stages are to be recovered in a zone, their neutralisation system shall be inhibited after nominal separation. It shall be possible to make this system safe before any recovery operation.

3. When the stages are recovered on-site, their neutralisation system shall be inhibited at a moment during the recovery phase, which minimises the risk of injuring anyone on the ground. The operator shall define this moment and justify this choice.

It shall be possible to make the neutralisation system safe before any handling on Earth.

SECTION 5: PARTICULAR RISKS

Article 24-1 - Cybersecurity.

The launch operator shall implement a cybersecurity policy and the resulting security measures, for protection against malicious cyber acts liable to compromise compliance with these regulations.

Justification of this policy and the summary of the security measures put in place shall be sent to the CNES.

Article 25 - Nuclear safety.

Any launch operator intending to transport radioactive substances on-board the launch vehicle shall comply with the applicable regulations in force and shall demonstrate application in the nuclear safety plan required by article 9 of the Order of February 23rd, 2022 concerning the composition of the three parts of the file mentioned in article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended.

Article 26 - Planetary protection.

Any launch operator conducting a launch to another celestial body, whether or not including the return of extra-terrestrial materials, shall comply with the international "Planetary protection policy" standard published by the Committee on Space Research (COSPAR) for implementation of Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies.

CHAPTER IV: TECHNICAL REQUIREMENTS CONCERNING THE LAUNCH SITE

Article 27 - Launch site.

1. For operations conducted from the Guiana Space Centre (CSG), the launcher shall be designed and produced to ensure compatibility with the systems and procedures resulting from the Order constituting the regulations of the exploitation of the CSG installations the issued by the Chairman of the CNES.

2. For operations run from another launch site and subject to the waivers granted under article 4.4 of the above-mentioned Act of June 3rd, 2008, the launch system shall be operated with systems and procedures implemented on said site, capable of performing the location, neutralisation and telemetry functions, designed to protect individuals, property, public health and the environment:

- the above-mentioned systems and procedures shall be compatible with the provisions of this Order;
- the launcher shall be designed and produced to ensure compatibility with the above-mentioned ground systems and procedures.
- cybersecurity measures shall be put in place to ensure that no unauthorized or unauthenticated remote command, likely to compromise compliance with these regulations, can be received and executed by the on-board systems.

3. The launch site used shall have sufficient means to ensure the safety of individuals, property, public health and the environment during implementation of the launcher or in the event of an accident.

PART THREE: CONTROL AND RETURN TO EARTH OF A SPACE OBJECT OR A GROUP OF COORDINATED SPACE OBJECTS

TITLE I: SCOPE

Article 28

The provisions of this part apply to the control and return of any space object, including those belonging to a group of coordinated space objects.

The provisions of this part do not apply to the control and return of stages and launcher elements covered by the provisions of the second part of this Order.

TITLE II: TECHNICAL FILE

CHAPTER I: REQUIRED DOCUMENTATION (REPEALED)

Article 29 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

Article 30 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

Article 31 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

Article 32 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

Article 33 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

Article 34 (repealed)

Repealed by Order of February 23rd, 2022 - Art. 12

CHAPTER II: QUALITY SYSTEM REQUIREMENTS

Article 35 - Competence, resources, organisation and installations.

1. For performance of the space operation, the operator shall implement and manage a quality management system as well as internal standards and quality management requirements. This management system shall cover quality assurance, RAMS (reliability, availability, maintainability, safety), configuration management and steering of works.

2. The operator shall have the competences, resources and organisation necessary for preparing and implementing the planned operation:

- appropriate installations and organisation;
- equipment and tools appropriate to the planned operation;
- documentation concerning tasks and procedures;
- access to data of use for preparation of the planned operation;
- recording, assessment and archival of technical data;
- key jobs and associated training process.

3. Until the end of the space operation, the operator shall retain:

- the definition of the materials used;
- the description and justification of the critical components of the space object or group of coordinated space objects with regard to protection of individuals, property, the environment and public health, in particular with regard to the production of space debris.

At the end of the space operation, after the disposal manoeuvres or if responsibility is transferred to another operator, these elements are sent to the CNES with a description of the state attained.

Article 36 - Technical and organisational events.

The operator shall set up an organisation enabling it:

- during the preparation and performance of the space operation, to identify and deal with all technical and organisational events that may affect the conditions of the space operation as authorised, in particular the disposal strategy;
- to inform the CNES, without delay, pursuant to article 7 of the above-mentioned Decree of June 9th, 2009, of all these technical and organisational events.

Article 37 - Technical reviews.

Technical reviews designed to check implementation of the provisions of this Order shall be scheduled by the operator prior to launch. The operator shall inform the CNES of the reviews prior to launch and prior to initiation of the space object disposal manoeuvres.

Article 38 - Co-contractors and subcontractors.

1. The operator shall ensure that its co-contractors and subcontractors apply all the measures necessary for establishing and maintaining compliance with this technical regulation.

2. The operator shall ensure that the persons mentioned above apply the provisions relating to organisation, quality assurance and engineering in compliance with the standards and practices recommended by the profession.

Article 38-1 - Inspection plan during on-orbit control.

The operator shall draw up a plan to inspect implementation of the provisions of this Order during the on-orbit control phase. This inspection plan includes briefings with the CNES at least once a year and in particular:

- after the initial launch and early orbit phase (LEOP);
- following transfer of control of the space object or group of coordinated space objects to another operator;
- before the beginning of the disposal manoeuvres;
- after the disposal manoeuvres;
- for on-orbit servicing operations, following performance of a service.
- Depending on the phase concerned, these briefings shall present the results of the operations performed or the availability of the vehicle for initiation of the upcoming operations, in particular:
- status of anomalies, on-board and orbital configuration;
- status demonstrating the ability of the space object to perform the disposal operations (manoeuvres and passivation);
- availability of the energy resources (propellant management in particular) needed for the disposal manoeuvres;
- results of manoeuvres performed to avoid other space objects and coordination with the other operators;
- status of ground segments.

Article 38-2 - Validation of procedures.

The space object control procedures shall be tested and validated by the operator before the launch, except for degraded cases which do not require any immediate reaction by the operator and end-of-life procedures if it is shown that there is no risk of having to perform an emergency disposal.

The operational sequences involving the object control procedures shall be tested and validated by the operator before the launch for the mission's critical phases (LEOP, disposal, critical operations in orbit).

CHAPTER III: TECHNICAL REQUIREMENTS COMMON TO THE ON-ORBIT CONTROL OPERATIONS (ARTICLES 39 TO 43)

SECTION 1: REQUIREMENTS RELATED TO THE PERFORMANCE OF OPERATIONS

Article 39 - Ability to control the space object.

The space system shall be designed, produced and implemented in such a way that the operator, for the duration of the operation, can receive information about the status of the space object and send it commands, with the aim of:

- preventing on-orbit collisions;
- being able to perform disposal or any other operation intended to keep the object intact.

Article 39-1 - Identification of space objects.

The space systems shall be designed, produced and implemented and their mission defined so that all space objects are unambiguously identifiable by the space surveillance systems as early as possible and within three days after injection.

Article 39-2 - Propellant management.

The probability, calculated prior to the launch, of having the propellant needed for the end-of-life manoeuvres, at each moment during the mission and up to initiation of successful disposal manoeuvres, shall be at least 0.99.

Article 39-3 - Cybersecurity.

The operator shall adopt a cybersecurity plan to ensure that no unauthorised or unauthenticated remote command that could compromise compliance with these regulations, can be received and executed by the on-board systems.

Article 39-4 - Case of an On-orbit service for a vehicle for which control has already been authorised.

An operator wishing to benefit from an on-orbit service shall ensure and demonstrate that the servicing vehicle complies with the specific requirements described in Chapter V.

SECTION 2: PREVENTION OF FRAGMENTATION

Article 40

1. Intentional release of debris.

The space systems implemented by the operator shall be designed, produced and implemented such that they do not generate debris during an operation when it takes place nominally.

The above provision shall not apply:

- to the pyrotechnic systems. However, these shall not generate products with the largest dimension of 1 mm or more;

- to solid or hybrid propellant boosters. They shall not however generate combustion debris of 1 mm or larger in protected regions A and B.

However, the on-orbit release of a single additional service module is acceptable. As a space object, this module shall comply with all the provisions of the third part of this Order.

2. Accidental break-up

The probability of occurrence of accidental break-up of any space object shall be less than 10^{-3} until the end of the disposal operations of this space object.

Its calculation shall include failure modes of propulsion and power systems, mechanisms and structures, but shall not take account of any external impacts.

In the event of detection of a situation causing such a failure, the operator must be capable of planning and taking corrective measures to avoid all disintegration.

3. Passivation

Any space object shall be designed, produced and implemented so that, following the disposal phase:

- all on-board energy reserves are permanently depleted or placed in a state such that they entail no risk of generating debris;
- all on-board energy production means are permanently deactivated, or all the equipment directly supplied by these energy production means are placed in a state such that they entail no risk of generating debris;
- the entire radio electric transmission capacity of the platform and payload shall be permanently interrupted.

The provisions of paragraph 3 of this Article do not apply to controlled re-entries.

Article 40-1 - Intentional destruction.

1. The operator shall avoid the intentional destruction of any space object in orbit.

2. When the operator intends to proceed with an intentional destruction, it notifies the Minister in charge of Space of the need to do so. This destruction may only take place at altitudes that are low enough to limit the lifetime in orbit of the fragments produced.

Article 40-2 - Devices for active debris removal.

Any space object shall be designed, produced and implemented in such a way as to facilitate, after its disposal, seizure or capture by an Active Debris Removal (ADR) servicing vehicle, as applicable.

SECTION 3: PREVENTION OF COLLISIONS

Article 41 - Prevention of the risks of collision with manned objects.

The space systems shall be designed, produced and implemented and their mission defined so that, during the space operation and for three days following the end of the operation, the risks of collision with manned objects for which the orbital parameters are accurately known and available are limited.

Article 41-1 – Collision avoidance capability.

Space systems of manoeuvring objects shall have an operational capability to detect a risk of collision and manage it either by carrying out a remote-controlled or autonomous manoeuvre to avoid the secondary object, or by ensuring coordination with the secondary object’s control centre when it is controlled, in order to decide on which of the

object(s) is to perform such a manoeuvre. The post-manoeuvre trajectory shall be such as to substantially reduce the initial collision risk.

Article 41-2 - Availability of collision avoidance manoeuvres.

Space systems of manoeuvring objects shall be designed and implemented such that they are available for performance of a collision avoidance manoeuvre within a maximum of 5 days after injection, or, in the case of a multiple launch of several satellites by a same operator, as soon as possible after injection, with a strategy minimizing the period of unavailability of the collision avoidance capacity.

Article 41-3 - Probability of collision with a space object.

The probability of occurrence – calculated before the launch – for the entire duration of the space operation, of an accidental collision with a space object larger than 1 cm shall be evaluated and minimized. In addition, this estimate shall include the return to Earth phase for a space object operating in region A.

Article 41-4 - Prevention of collisions at separation from a launcher or dispenser.

At separation between the launcher or dispenser and the space object it injects:

1° The operator controlling the space object injected shall ensure that the launcher or dispenser operator can guarantee:

- that each object it injects is on a trajectory leading to no collision with either the launcher or the dispenser, nor with the other injected objects, for a minimum duration of 5 days following injection, or until the space object is capable of performing collision avoidance manoeuvres;
- that each of the injected objects follows a trajectory that does not lead to a collision with manned objects for a minimum duration of 3 days following injection, or until the space object is capable of performing collision avoidance manoeuvres.

2° The operator controlling the dispenser which injects one or more space objects shall guarantee:

- that each of these objects is on a trajectory leading to no collision with either itself or with the other injected objects, for a minimum duration of 5 days following injection, or until the space object is capable of performing collision avoidance manoeuvres;
- that each of the injected objects follows a trajectory that does not lead to a collision with manned objects for a minimum duration of 3 days following injection, or until the space object is capable of performing collision avoidance manoeuvres.

Article 41-5 - Coordination in the event of collision alert between two operators controlling manoeuvring space objects.

In the event of a confirmed collision alert between two manoeuvring space objects, the operator bound by these regulations shall coordinate with the other operator in order to decide on a manoeuvre strategy leading to manoeuvring at least one of the two objects.

Article 41-6 - Trigger threshold for collision avoidance manoeuvres.

In the event of a collision alert with a catalogued space object, the collision avoidance measures take priority over the mission. The collision probability threshold above which the operator must implement measures to avoid a collision shall be defined, and its adequacy shall be demonstrated, in the operational concept.

Article 41-7 - Data sharing.

The operator shall share, as soon as possible after injection by the launcher and within 3 days, the necessary updated information with any pertinent actor or entity, in order to control the risks of collision with the catalogued space objects it could encounter. This information shall be at least the following:

- ephemeris, resulting from the operator's own orbit determination means, or from Space surveillance systems;
- manoeuvre plan;
- covariances.

SECTION 4: PREVENTION OF SATURATION OF ORBITS

Article 41-8 - Disposal obligation.

1. The space systems shall be designed, produced and implemented such that, following their operational phase, they perform disposal by either:

- -escape from Earth's gravity;
- -atmospheric re-entry, controlled or otherwise;
- -entering a graveyard orbit between protected region A and protected region B;
- -entering a graveyard orbit above protected region B.

2. With regard to space objects which, during their operational phase, are in an orbit included within or passing through protected region A, only escape from the operational orbit by atmospheric re-entry is authorised.

3. With regard to space objects which, during their operational phase, are in an orbit included within or passing through protected region B: if the eccentricity of the target graveyard orbit for the space object after the disposal manoeuvres is less than 0.1, it shall be situated above protected region B.

Article 41-9 - Maximum orbital lifetime before atmospheric re-entry.

If disposal of the space object leads to atmospheric re-entry, the residual time in orbit may not exceed:

- -three years for systems with an operational phase of less than 1 year;
  or
- -three times the duration of the operational phase and in any case may not exceed twenty-five years.

This residual time in orbit is considered as soon as there is no manoeuvring capacity.

For the purpose of this article, the operational phase begins when the initial operator takes control of the object considered.

Article 41-10 - Characteristics of a graveyard orbit between protected region A and protected region B.

A graveyard orbit between protected region A and protected region B shall be such that, under the effect of natural disturbances and the associated uncertainties, for one hundred years following the end of the disposal phase, the space object does not return to either protected region A, nor protected region B, nor interferes with the operational orbits of the constellations already present between these two regions.

Article 41-11 - Characteristics of a graveyard orbit above protected region B.

A graveyard orbit above protected region B shall be such that, under the effect of natural disturbances, for one hundred years following the end of the operation, the space object does not return to protected region B.

Article 41-12 - Reliability of disposal operations.

The probability of being able to successfully carry out the disposal operations (including the passivation operations as well as the disposal manoeuvres) shall be 0.9 or greater.

Article 41-13 - Limitation of the orbit of non-manoeuvring space objects.

Systems not equipped with propulsion capable of modifying the orbit shall be designed, produced and implemented for orbits with an apogee of less than 600 km.

Article 41-14 - Radio electric emissions.

The operator shall comply with the applicable radiofrequency regulations from its operational orbit and shall conduct in-flight coordination with the other operators to avoid all radio interference.

SECTION 5: PARTICULAR RISKS

Article 42 - Nuclear safety.

Any operator intending to implement radioactive substances on-board the space object shall comply with the applicable regulations in force and shall demonstrate their application in the nuclear safety plan required by article 17 of the Order of February 23rd, 2022 concerning the composition of the three parts of the file mentioned in article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended.

Article 43 - Planetary protection.

Any operator intending to conduct a mission to another celestial body, whether or not this includes the return of extra-terrestrial material, shall comply with the international "Planetary protection policy" standard published by the Committee on Space Research (COSPAR) for implementation of Article IX of the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies. The operator shall demonstrate its application in the planetary protection plan set out in Article 17 of the above-mentioned Order of February 23rd, 2022.

CHAPTER IV: SPECIFIC TECHNICAL REQUIREMENTS FOR THE RETURN OF A SPACE OBJECT

Article 44 - Quantitative objectives for human safety for return to Earth of a space object.

1. With regard to the return of a space object, the quantitative safety objectives, expressed as the maximum probability of causing at least one casualty (collective risk) is 10^{-4}.

2. The provisions mentioned in 1 of this Article shall be evaluated by taking account of:
- the atmospheric re-entry strategy (controlled or uncontrolled);
- the population on the intended date of re-entry;
- all phenomena leading to a risk of catastrophic damage;
- the trajectories before fragmentation;
- modelling of the scenarios covering fragmentation and the corresponding generation of debris on re-entry;
- dispersion of debris on the ground and evaluation of their effects;
- the reliability of the space object.

3. These objectives comprise the risk associated with the nominal return of the object or fragments thereof as well as that associated with non-nominal cases. These objectives in no way prejudice the provisions of Articles 42 and 45 of this Order.

Article 45 - Requirements concerning uncontrolled re-entry of a space object foreseen at its end-of-life.

The systems shall be designed, produced and implemented so that the elements which manage to reach the surface of the Earth entail no unacceptable risk for property, public health or the environment, in particular through pollution of the environment by hazardous substances.

Article 46 - Prevention of risks arising from fall-back of the space object or fragments thereof during a controlled re-entry.

1. The operator shall demonstrate that there is no risk of on-orbit collision with manned stations following the de-orbiting and return to Earth manoeuvres.

2. The operator shall determine the fall-back zones of the space object and fragments thereof for any controlled atmospheric re-entry to Earth, associated with a probability of 99% and 99.999% respectively. These fall-back zones shall take account of the uncertainties linked to the re-entry parameters.

3. The fall-back zone, associated with a probability of 99.999%, shall not impinge on the territory, including the territorial waters, of any State, without its agreement.

In the event of a fall-back zone being situated in a region with heavy maritime or air traffic or in which fixed and manned oil platforms are located, a special analysis shall be carried out, pursuant to Article 15 of the above-mentioned Order of February 23rd, 2022.

4. The organisation and resources put in place by the launch operator shall enable the Chairman of the CNES:
- to inform the competent authorities in charge of air and maritime traffic control of the fall-back zones in a nominal situation, specifying the zones receiving 99% of these fall-backs;
- to transmit to the competent authorities the information concerning the fall-back zone of elements, so that the authorities of the states concerned can be warned as early as possible of any degraded situation;
- to provide all useful information at its disposal so that the necessary response plans can be determined and implemented by the competent authorities.

Article 46-1 - Controlled re-entry to a site.

If a space object is performing a controlled re-entry to a French or foreign site designed for that purpose, said object shall be designed, produced and implemented such as to ensure compatibility with the systems and procedures of the landing site in question. It may only land on this site once authorised by the authorities responsible for the landing site.
If the object performing re-entry to a site has separated from a service module beforehand, the risks of any casualties caused by fall-back of fragments of this latter shall be less than 10^{-4}, including for the orbital composite in the event of non-separation.
For the object performing re-entry to the site, the operator shall demonstrate that the risk of casualties on the ground is less than $2*10^{-5}$.
For the return and landing phase, the operator shall identify the failure scenarios at the origin of abnormal situations leading the orbital vehicle to become a hazard, in particular in the following cases:
- deviation from the predetermined re-entry corridor;
- dangerous fall-back and recovery phase for those elements designed to detach;
- non-nominal behaviour of landing flight control.

The operator shall qualitatively and quantitatively deduce the need or not for on-board systems allowing neutralisation of the orbital vehicle before the moment at which the impact zone is, in full or in part, within a territory placed under the sovereignty of any State encountered along its nominal trajectory, including its territorial sea.

Article 47 - Non-nominal re-entries.

In the case of premature or accidental re-entry, the operator as a priority implements all measures such as to reduce the risk on the ground.

CHAPTER V: SPECIFIC TECHNICAL REQUIREMENTS FOR ON-ORBIT SERVICING

SECTION 1: REQUIREMENTS FOR ALL PHASES

Article 47-1 - Collection of debris created.

If the on-orbit servicing operation entails compromising the integrity of the target object, the operator of the servicing vehicle shall collect the intentionally created debris of 1 mm or more along its largest dimension, in compliance with the other provisions of this chapter, so that it is not released into outer space.

Article 47-2 - Survival and collision.

The on-board systems of the servicing vehicle shall be designed and implemented such that triggering of survival mode by said servicing vehicle leads to no risk of collision with the target object.

Article 47-3 - Compatibility of target object.

The servicing vehicle shall demonstrate that its design and operational concept are compatible with the systems of the target object, or if the target object is space debris, with its condition.

Article 47-4 - Mission impact on a third party.

The on-orbit servicing operation shall be conducted without prejudice to or interference with the operations of third parties not involved in this operation.

SECTION 2: REQUIREMENTS IN THE PROXIMITY ZONE

Article 47-5 - Proximity zone volumes and corridors.

In the proximity zone, the operator of the servicing vehicle shall define the volumes around the target object in which the servicing vehicle can move and those which it shall not enter.

The approach corridors in particular shall be defined by the servicing vehicle operator.

The systems of the servicing vehicle shall be designed, produced and implemented such that any deviation from these corridors in flight is continuously monitored and triggers a back-up solution enabling the servicing vehicle to be placed in a state or initiate movement which does not compromise the safety and integrity of the two objects.

Article 47-6 - GO/NOGO criteria.

For the purposes of the approach phase and in order to initiate separation, the operator of the servicing vehicle shall define holding or passage points in the operational concept. For these points, the minimum required on-board and ground configurations (states) and the absolute and relative orbital configurations (position, speed, attitude, angular velocity) permitting the continuation or abortion of operations shall be defined in advance and for each object . These verification points are mandatory before entering the various volumes of the proximity zone.

Article 47-7 - Coordination of control centres.

The control centres of the servicing vehicle and the target object shall be perfectly coordinated, with the following principles:

- sharing of all the data and telemetry needed to ensure the safety of the operations;
- for each phase, identification of the control centre (servicing vehicle or target object) with the decision-making authority for the joint operations in the proximity zone, including during the attached phase, and the control centre which controls the composite in the attached phase.

The above provision does not apply if the space object is space debris.

Article 47-8 - Vehicle/Ground communications.

Continuous vehicle/ground communications and surveillance shall be implemented in order to maximise the safety of the critical phases of the on-orbit servicing operations.

The contact phase, up to capture, the operations considered to be critical in the attached phase and the separation shall be performed with continuous telemetry/telecommand visibility.

In the proximity zone and during the approach and distancing phases, continuous telemetry/telecommand visibility is not required if an operational concept with sufficient autonomy in terms of operations safety can be demonstrated.

Article 47-9 - Secure on-board service communications.

The on-board and ground systems of the servicing vehicle shall be designed, produced and implemented such that vehicle/ground and vehicle/vehicle communications are secure and therefore resilient to all corruption with the potential to compromise the safety of the operations.

Article 47-10 - Vicinity check.

The operator of the servicing vehicle shall, for all operations performed in the proximity zone, ensure that only those objects taking part in the ongoing operation are in its vicinity in order to avoid any collision. The operational concept shall thus define the safety zone within which the presence of a third party shall be a reason for the ongoing operation not to be carried out or to be aborted.

Article 47-11 - Emergency avoidance capability.

In the proximity zone, during the approach phase and after separation, the servicing vehicle's on-board systems shall be able to evaluate the risk of collision between the servicing vehicle and the target object in real time.

These systems shall be able to autonomously trigger an avoidance manoeuvre which should place the vehicles on relative trajectories ensuring no conjunction with the other for a time frame compatible with total control of the combined mission being restored, to guarantee the required level of safety.

Article 47-12 - Good operating tests of the servicing vehicle.

The operator of the servicing vehicle shall perform good operating tests on the equipment needed for the on-orbit service operations and their safety, except for non-reversible operations, at least before initiating the first servicing and in conditions which represent no danger for any other space object.

Article 47-13 - Plume effect prevention.

In the proximity zone, the servicing vehicle shall be designed, produced and implemented to avoid causing damage by contamination of the target object as a result of the jet effects from its propulsion system.

The above provision does not apply if the space object is space debris.

SECTION 3: REQUIREMENTS OF THE APPROACH AND CONTACT PHASE

Article 47-14 - Qualification of approach and docking concepts.

Any new approach, docking or undocking concept or technology for the servicing vehicle shall be qualified. Qualification shall include:

- a ground demonstration in all cases;
- if the ground demonstration cannot be shown to be representative of the hazards inherent in the operation, an in-flight demonstration by successful docking with a target object in an orbit below 600 km, above region B, or between regions A and B.

Article 47-15 - Inspection before docking.

Any docking with a target object shall be subject to prior in-flight inspection of said target object and, if possible, of the servicing vehicle, in order to check that no interference – mechanical in particular – could lead to failure of docking, or disrupt relative navigation. The servicing vehicle shall remain at a holding or parking point until such time as the evaluation of the inspection allows the operation to continue.

Article 47-16 - Performance for approach phase safety.

The systems of the servicing vehicle shall be designed, produced and implemented to guarantee, in the approach phase, a probability of violation of the flight corridors defined in the approach and docking operational concepts, and thus a risk of collision between the 2 vehicles, of less than 1% per approach, and less than 5% over the entire orbital lifetime of the servicing vehicle.

Article 47-17 - Electrostatic and electromagnetic compatibility at contact.

The servicing vehicle shall be designed and produced with the necessary protections, so that during the contact phase, it cannot create any ESD (electrostatic discharge) and EMC (electromagnetic compatibility) damage.

SECTION 4: REQUIREMENTS OF THE ATTACHED PHASE

Article 47-18 - Control of the composite in the attached phase.

It must be possible to attitude and orbit control the composite in particular in order to retain collision avoidance capability.

For a joint operation between two distinct entities, the entity in charge of controlling the composite shall be identified.

This entity shall be in charge of collision avoidance manoeuvres, as necessary. It shall take all necessary steps to ensure compliance with the provisions required in sub-section 3 of Chapter III of Section II of Part three of this Order.

SECTION 5: REQUIREMENTS OF THE SEPARATION AND DISTANCING PHASE

Article 47-19 - Separation reliability.

The calculated probability of successful nominal separation and distancing from the servicing vehicle outside the proximity zone shall be evaluated and maximized.

Article 47-20 - Integrity of target object at separation.

The systems of the servicing vehicle shall be designed, produced and implemented such that, at separation of the composite, the servicing vehicle does not definitively degrade the vital functional capabilities of the target object, in particular its attitude control and disposability.

The above provision does not apply if the space object is space debris.

Article 47-21 - Separation dynamics.

The systems of the servicing vehicle and of the target object shall be designed, produced and implemented such that separation enables the two objects to move apart along a trajectory where any drift creates no risk of collision between them over a time frame compatible with implementation of a collision avoidance manoeuvre.

CHAPTER VI: TECHNICAL REQUIREMENTS SPECIFIC TO CONSTELLATIONS

Article 48-1 - Probability of disposal of the satellites of a constellation.

Each satellite in a constellation shall have a probability of success of the disposal operations (including the passivation operations and the disposal manoeuvres) with the following rule:

- constellation in which the number (N) of satellites is less than 50: $P > 0.9 + N \times 0.001$;
- constellation in which the number (N) of satellites is greater than or equal to 50: $P > 0.95$.

Where N is the number of satellites in the constellation, N greater than or equal to 10.

Article 48-2 - Probability of causing casualties on the ground.

The quantitative safety objective including all returns to Earth by the satellites of a mega-constellation, expressed as a maximum allowable probability of causing at least one casualty (collective risk), is 10^{-2}.

Article 48-3 - Incorporation of experience feedback.

All experience feedback resulting from the in-flight failure of a satellite belonging to a constellation undergoing deployment and, more generally, from any incident or technical event affecting the conditions of the space operation as authorised, shall be taken into account for the launch of the subsequent satellites.

Article 48-4 - Intra-constellation collisions after disposal.

Satellites in the same constellation shall be decommissioned such as to guarantee a risk of intra-constellation collision of less than 10^{-3} until their atmospheric re-entry, or for 100 years in the graveyard region approved for constellations located outside region A.

Article 48-5 - Collision avoidance capability for mega-constellations.

Each satellite in a mega-constellation shall have an on-board propulsion system so that it is able to perform effective collision avoidance manoeuvres in due time, up until the end of its disposal.

Article 48-6 - Vital system tests before reaching operational orbit for mega-constellations.

Before a satellite of a mega-constellation reaches its operational orbit, good health checks shall be run, from an intermediate orbit, on the subsystems of its platform needed for disposal.

For satellites operating in region A, this intermediate orbit shall allow natural re-entry in less than 5 years and shall have an apogee below the perigee of the operational orbit.

Article 48-7 - Maximum duration of disposal for the satellites of a mega-constellation.

For each satellite of a mega-constellation operating in region A, the maximum presence in orbit after disposal shall be limited to:

- 5 years for mega-constellations in which the total number of satellites is less than 1,000;
- 2 years for mega-constellations in which the total number of satellites is greater than or equal to 1,000.

Article 48-8 - Separation of intra-constellation planes.

The geometry of a constellation shall be defined such as to ensure sufficient separation between the satellites of this constellation with the aim of guaranteeing robustness to the collision risk.

Article 48-9 - Separation between mega-constellations.

The geometry of a mega-constellation shall not intercept the geometry of another mega-constellation already in orbit, guaranteeing adequate radial separation, up until the beginning of disposal of the mega-constellation.

If it is not possible, and duly justified, to guarantee adequate radial separation, the operator shall demonstrate robustness with regard to the risk of collision between its satellites and those of the other mega-constellation.

Article 48-10 - Limitation of optical disruptions by the satellites of a mega-constellation.

Each satellite of a mega-constellation shall be designed, produced and implemented with the objective of attaining an apparent magnitude of 7 or more in order to minimize optical disruptions for astronomical observations from the ground or space.

CHAPTER VII: MISSION EXTENSION

Article 49-1

If extension of the mission beyond the initially authorised duration is intended, the operator shall demonstrate that such mission extension does not compromise compliance with the operational provisions of the third part of this Order.
In addition, with respect to the hazard study, the feared events specific to the mission extension shall be identified and managed.
The contribution of a servicing vehicle intervening during this mission extension shall be evaluated with regard to the provisions of this Order.

TITLE III: OBLIGATIONS RELATING TO PERFORMANCE OF THE SPACE OPERATION (REPEALED)

Article 48 (repealed)

Repealed by Order of June 28th, 2024 - Art. 46

Article 49 (repealed)

Repealed by Order of June 28th, 2024 - Art. 46

PART FOUR: PRELIMINARY COMPLIANCE WITH THE TECHNICAL REGULATION

TITLE I: SCOPE

Article 50 - Scope of preliminary compliance.

Under article 11 of the above-mentioned Decree of June 9th, 2009, the following critical systems and subsystems may be submitted to the CNES:

- the space system;
- the space object or group of coordinated space objects;
- the space object platform, associated with a command control system as applicable;
- the propulsion subsystem of a launcher;
- the autonomous flight termination system of a launcher;

Article 51 - Preliminary compliance time frame.

The file stipulated in the first paragraph of Article 11 of the above-mentioned Decree of June 9th, 2009 shall be created in accordance with the requirements of Article 50 of this Order. It shall be submitted to the CNES during development of the system or subsystem concerned, and no earlier than the end of the preliminary design phase.

The document certifying preliminary compliance with this technical regulation may be issued by the CNES following the design and development steps of the system or subsystems below:

- preliminary design;
- detailed design;
- production and ground testing designed to check compliance with the requirements of this Order for the system or subsystem concerned;
- qualification.

TITLE II: PROCEDURE FOR ISSUANCE OF THE DOCUMENT EVIDENCING COMPLIANCE

Article 52 - Documents to be provided.

1. For a launch system, the bidder shall provide some or all, depending on the system concerned, of the documents required by Chapter I of Section II of the Order of February 23rd, 2022 concerning the composition of the files mentioned in article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended.

2. For a space system other than a launch system, the bidder shall provide some or all, depending on the system concerned, of the documents required by Chapter II of Section II of the Order of February 23rd, 2022 concerning the composition of the files mentioned in article 1 of Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, as amended.

Article 53 - Checks, tests and analyses.

On the basis of the documents provided pursuant to Article 52 of this Order, the CNES specifies all the checks, tests and analyses as provided for in the second paragraph of Article 11 of the above-mentioned Decree of June 9th, 2009.
With regard to a launch system, these requests may also concern compatibility with the systems and procedures of the site from which the space operation is carried out.

PART FIVE: GUIDE OF GOOD PRACTICES

SINGLE TITLE

Article 54 - Guide of good practices.

1. Two guides of good practices, one for launchers and the other for satellites, are drawn up by the CNES, jointly with the profession, through a working group representative of the operators and industrial firms concerned, in order to characterise certain practices in force, thereby helping to demonstrate compliance with this technical regulation.

These guides are based on practices validated by the experience acquired in the development, operation and inspection of space systems. They are in particular based on standards, technical specifications constituting standards, and standards recognised by the profession relating to the safety of life, property, public health and the environment within the context of space operations. The contents of these guides comply with the applicable requirements for protection of intellectual property as well as industrial and scientific assets.

2. Compliance with all or part of the requirements of this technical regulation is deemed to be acquired if the operator can demonstrate compliance with the relevant recommendations of these guides.

The use of a guide of good practices is neither mandatory nor exclusive.

PART SIX: INTERIM AND FINAL PROVISIONS

Article 55 - Interim provisions.

With regard to the space object or group of coordinated space objects control and return operations, the following interim provisions are implemented:
1° For space objects or groups of space objects for which the authorisation application under article 2 of the above-mentioned Act of June 3rd, 2008 is submitted between July 1st, 2024 and December 31st, 2026:
a) With regard to the provisions of articles 41-12 (reliability of disposal operations) and 48-1 of this Order (probability of disposal of the satellites of a constellation), a probability of being able to complete disposal operations with success of 0.85 is required for satellites alone, and the following rule is applied for each satellite of a constellation (N being the number of satellites in the constellation):

- constellation in which the number (N) of satellites is less than 50: $P > 0.85 + N \times 0.001$;
- constellation in which the number (N) of satellites is greater than or equal to 50: $P > 0.90$.

b) With regard to the provisions of article 41-2 of this Order (availability of collision avoidance manoeuvres), the operator shall present a strategy that minimizes the period of unavailability of collision avoidance capability;
c) With regard to the provisions of article 41-7 of this Order (data sharing), the operator of a non-manoeuvring object or a group of non-manoeuvring objects shall implement the best possible strategy taking account of the definition of the space object or the group of coordinated space objects;
d) With regard to the provisions of article 41-9 of this Order (maximum orbital lifetime before atmospheric re-entry), the operator shall implement the best possible strategy enabling achievement of the objective of the article within the limit of 25 years of atmospheric re-entry time;

2° For space objects or groups of space objects for which the authorisation application under article 2 of the above-mentioned Act of June 3rd, 2008 is submitted between July 1st, 2024 and December 31st, 2028:
a) With regard to the provisions of article 39-1 of this Order (identification of space objects), an identification within one week is acceptable for manoeuvring objects launched in clusters, and a detectability of non-manoeuvring objects within 3 days is considered acceptable;
b) With regard to the provisions of article 48-4 of this Order (intra-constellation collisions after disposal), the operator shall present a detailed analysis of the disposal strategy implemented to limit risks of intra-constellation collisions after disposal;
c) With regard to the provisions of article 48-10 of this Order (limitation of optical disruptions by satellites of a mega-constellation), the operator shall minimize optical disruptions by the satellites of a mega-constellation to limit interference for astronomical observations;
d) The provisions of article 40-2 of this Order (active debris removal systems) are not applicable.

Article 55-1

The provisions of this Order, as amended by the Order of June 28th, 2024 amending the Order of March 31st, 2011 concerning the technical regulation implementing Decree 2009-643 of June 9th, 2009 concerning authorisations issued pursuant to Act 2008-518 of June 3rd, 2008 relating to space operations, apply to authorisation applications submitted on or after July 1st, 2024.

Article 56

The Chairman of the CNES is responsible for execution of this Order, which will be published in the Official Gazette of the French Republic.

Signed on March 31st, 2011.

For the Minister and by delegation:
The Director General for Research and Innovation