EXHIBIT 2

DECREE CONCERNING TECHNICAL REGULATIONS IMPLEMENTING DECREE NO. 2009-643 OF 9TH JUNE 2009 CONCERNING LICENSES ISSUED PURSUANT TO ACT NO. 2008-518 OF 3RD JUNE 2008 RELATING TO SPACE OPERATIONS

DECREE CONCERNING TECHNICAL REGULATION IMPLEMENTING DECREE NO. 2009-643 OF 9TH JUNE 2009 CONCERNING LICENSES ISSUED PURSUANT TO ACT NO. 2008-518 OF 3RD JUNE 2008 RELATING TO SPACE OPERATIONS

NOR : *ESRR1103737A*

The Ministry for Higher Education and Research,

Having regard to the Research Code, in particular chapter 1 of part III of book III;

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

Having regard to decree no. 2009-643 of 9th June 2009 concerning licenses issued pursuant to the Act of 3rd June 2008 concerning space operations, in particular its article 1;

Decree:

PART ONE

DEFINITIONS AND PRELIMINARY PROVISIONS

Article 1 – Definitions

The following definitions are used in this decree:

"**Allocation**": level of probability given to the occurrence of a critical or specified event, when determining the safety objectives;

"**Catastrophic damage**": immediate or deferred loss of human life, or serious human injury (bodily injuries, other irreversible health impairments, occupational invalidity or illness, either permanent or temporary);

"**Controlled re-entry**": atmospheric re-entry of a space object with a predefined contact or ground impact zone for the object or fragments thereof;

"**Disposal phase**": final phase of the space operation during which the space object is made safe in order to limit the risks related to space debris.;

"**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 vehicle is liable to fly and outside of which it is neutralised;

"**Hazard level**": probabilistic estimate characterising the "lack of safety" of a system with regard to a critical event, expressed by the probability of occurrence of this event;

"**Irreversible moment**": for a launch operation, time at which the last order leading to launch vehicle lift-off is sent;

"**Launch vehicle**": assembly comprising the launcher and the space objects intended to be placed into orbit.

"**Neutralisation**": action taken on the launcher in order to minimise damage to individuals and property. It can in particular be characterised by an action to destroy or stop the thrust of a launch vehicle, in order to terminate the flight of the considered vehicle or 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 means involved in neutralising the launch vehicle in flight;

"**Operational phase**": period of time which, during an operation involving control in extra-atmospheric space, begins at the moment the operator takes control of the space object and ends with the beginning of the disposal phase;

"**Procedure**": specified way of carrying out an activity or process;

"**Process**": Set of correlated or interactive activities which transform input elements into output elements;

"**Protected regions**":

1) protected region A, low Earth orbit (LEO) – spherical region extending from the surface of the Earth up to an altitude (Z) 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
- -15 degrees ≤ latitude ≤ +15 degrees
- geostationary altitude " (Z GEO) = 35,786 km (altitude of geostationary terrestrial orbit);

"**Return**": period which starts at re-entry of the space object into the Earth's atmosphere and ends when it is immobilised on the ground, as part of a controlled or uncontrolled re-entry;

"**Safety**": set of arrangements intended to control risks in order to ensure protection of people, property and public health and the environment.

"**Safety coefficient**": the 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 scattering specific to each field concerned;

"**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 man made object, including fragments and elements thereof, in Earth orbit or re-entering the Earth's atmosphere;

"**Space object**": any man made object, functional or not, during launch time, its time spent in extra-atmospheric space or return, including the elements of a launcher placed into orbit;

"**Space system**": arrangement consisting of one or more space objects and the associated equipment and installations needed to perform a specified mission. With regard to a launch operation, the space system contains the launcher, the interfaced launch base, including the tracking stations, and the space object to be launched. With regard to a control operation, the space system consists of the space object and the interfaced ground segment..

"**Technical hazard**": hazard of technological, industrial, operational, man-made or natural origin. Expression used to differentiate between a technical hazard and all other types of hazards, in particular financial or related to installations safety;

"**Uncontrolled re-entry**": atmospheric re-entry of a space object for which it is not possible to predefine the ground impact zone by 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 in charge of space, following a conformity verification by the Centre national d'études spatiales (CNES), grants an authorization to carry out a space operation, pursuant to the above-mentioned Act of 3rd June 2008.

2. The provisions of this order apply to the space operations mentioned in articles 2 and 3 of the above-mentioned Act of 3rd June 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:

- to a launch operation which meets all of the following criteria:
  - lift-off from the ground;
  - rocket propulsion;
  - unmanned flight.
- to an operation to control an unmanned space object in extra-atmospheric space;
- 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 3rd June 2008.

5. Personnel who, pursuant to article 7 of the above-mentioned Act of 3rd June 2008, are authorised to verify compliance with the provisions stipulated with reference to these technical regulation and appended to the licensing order, are placed under the authority of the President of the Centre national d'études spatiales in the conditions stipulated in the order to authorise them.

PART TWO

LAUNCH OF A SPACE OBJECT

SECTION 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.

SECTION II

TECHNICAL FILE

Chapter 1 – Required documentation

Article 4 – Description of the space operation and systems and procedures

The description of the space operation and systems and procedures mentioned in II.1° of article 1 of the above-mentioned decree of 9th June 2009 presents the components of the launch system, the characteristics of the space object to be launched and the intended mission.

Article 5 – General notice of conformity

1. In accordance with II.2°a) of article 1 of the above-mentioned decree of 9th June 2009, the launch operator establishes a general notice of conformity with these technical regulation.

2. This general notice of conformity:

- identifies the documents supplied in accordance with articles 6 to 10 of this order;
- establishes the resulting conformity.

Article 6 – Internal standards and quality management provisions

In accordance with II.2°b) of article 1 of the above-mentioned decree of 9th June 2009, the launch operator produces documents justifying compliance with the requirements of chapter 2 of this section.

Article 7 – Hazard study

In accordance with II.2°c) of article 1 of the above-mentioned decree of 9th June 2009, the launch operator carries out a study of the potential hazards involved in the planned space operation.

This study includes a description of all the hazards related to the operation in nominal and accidental operating situations, whether their cause is internal or external. The study specifies the nature and scope of the possible consequences of all these operating situations. When dealing with elements of the launch vehicle which are returned or which fall-back and are liable to reach the ground, the study presents the components of these elements, stating their dimensions, masses and materials used.

The launch operator must therefore:

- demonstrate compliance with the requirements of article 20 of this order, with regard to the risk of injury to individuals;
- evaluate the effects of any accidents on public health and the environment.

This study must cover the following events, in the conditions stipulated in chapter 3 of this section:

- damage linked to fall-back of elements designed to separate from the launcher;
- damage linked to controlled or uncontrolled re-entry of launcher elements placed in earth orbit;
- damage linked to failure of the launch vehicle;
- collision with manned space objects, for which the orbital parameters are precisely known and available;
- damage linked to explosion of a stage in orbit;
- collision with a celestial body.

The study must present an exhaustive analysis of the causes and consequences, as well as the probabilities of the above-mentioned critical events. The risk reduction measures such as to comply with the requirements of articles 18 to 26 of this order are listed in the risk management plans laid out in article 9 of this order.

Article 8 – Impact assessment

In accordance with II.2°d) of article 1 of the above-mentioned decree of 9th June 2009, the launch operator carries out an environmental impact assessment for the planned operation.

During nominal operation of the launch system, the impact assessment must cover the impact of the planned operation on the environment and on public health, having regard to the provisions of article L 161-1 of the Environment Code, as well as the impact in terms of generation of space debris, in accordance with the provisions of article 21 of this order.

This impact assessment takes account of:

- working motor phases, in particular characterisation of the nature and quantification of the rates of atmospheric and extra-atmospheric combustion products during the powered flight;
- fall-back of launcher elements, in particular the characterisation of the nature and quantification of the products falling back on land, sea or onto a celestial body.

This assessment also covers the impact of:

- the production of space debris;
- as applicable, the carriage of radioactive materials on-board the launch vehicle.

Article 9 – Hazard management measures

In accordance with II.2°e) of article 1 of the above-mentioned decree of 9th June 2009, and on the basis of the conclusions of the hazard and impact assessments mentioned in articles 7 and 8 above, the launch operator draws up and implements the following hazard management plans:

- the environmental damage prevention plan, which lists the steps taken to mitigate the negative environmental impacts identified in the impact assessment mentioned in article 8 of this order, except for those concerning the space debris limitation and nuclear safety;

- the space debris limitation plan, demonstrating compliance with the requirements of article 21 of this order;

- the prevention plan concerning hazards resulting from the fall-back of space objects or fragments thereof, demonstrating compliance with the requirements of articles 20, 23 and 24 of this order;

- the prevention plan concerning the risks of collision, demonstrating compliance with the requirements of article 22 of this order;

- as applicable, the nuclear safety plan, demonstrating compliance with the requirements of article 25 of this order;

- as applicable, the planetary protection plan, demonstrating compliance with the requirements of article 26 of this order.

Article 10 – Emergency measures

In accordance with II.2°f) of article 1 of the above-mentioned decree of 9th June 2009, the launch operator lists the emergency measures planned and the organisation implemented for the protection of human safety.

This list must in particular include the means necessary for implementing paragraph 3 of article 23 of this order.

Chapter 2 – Quality system requirements

Article 11 – Quality assurance

1. When carrying out the space operation, the launch operator must implement and manage a quality management system as well as internal standards and quality management requirements in conformity with article 1 of the above-mentioned decree of 9th June 2009. This management system must cover quality assurance, dependability and safety (RAMS : reliability, availability, maintainability, safety), configuration management and supervision of work.

2. The space system must 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 must be installed. This system should allow traceability of technical and organisational events affecting engineering and production activities.

4. The quality management system in particular deals with the following technical or organisational events:

- deviations (anomalies, evolutions) in relation to the configuration (definition, launch system production and implementation process) which has been subject of the authorization or, as applicable, the license,
- deviations (anomalies, evolutions) resulting from exploitation of parameters recorded in-flight, likely challenging the conditions in which the authorization or, as applicable, the license, was granted.

5. The description and justification of launcher behaviour, and the definition of the materials used, must be retained until the end of the space operation concerned. Following it, these elements are transmitted to the Centre national d'études spatiales with the description of the state reached.

Article 12 – Competence, resources, organisation and installations

The launch operator must 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, analysis and archival of technical data,
- key jobs and associated training process.

Article 13 – Technical visibility

The launch operator must set up an organisation enabling it, in compliance with article 7 of the above-mentioned decree of 9th June 2009 and without delay, to inform the Centre national d'études spatiales of any technical or organisational events as mentioned in the 4th paragraph of article 11 of this order.

Article 14 – Technical reviews

1. Technical reviews to check implementation of the provisions of this order must be scheduled by the launch operator. These reviews can also be carried out as a part of reviews conducted elsewhere.

2. The launch operator must inform the Centre national d'études spatiales of the reviews prior to launch. The personnel qualified in compliance with article 7 of the above-mentioned Act of 3rd June 2008 may attend them in the conditions laid down in the same article.

Article 15 – Co-contractors, subcontractors and customers

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

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

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

Chapter 3 – Specific technical requirements for the launch operations

Sub-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 this order, the launch operator must furnish proof of:

a) the technical standards framework utilised;

b) consideration of the climatic environment in which the system is operated;

c) the ability of the launch system and its subsystems to perform the mission. This includes:

- description, dimensions;
- tests and/or modelling, readjustment and precision of the associated models, which must 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 launch resources interfacing with the launcher (surveillance thresholds);

d) the management and reproducibility, as necessary, of the industrial manufacturing, inspection and deployment processes;

e) incorporation into the design of RAMS analyses, including reliability assessments and identification of critical points;

f) incorporation of measures resulting from the launch system hazard analyses and operational hazard analyses;

g) incorporation of experience feedback from processing of technical events during development, production, testing and flight;

h) scenarios for fragmentation and generation of space debris at re-entry or neutralisation of the launch vehicle.

2. The proof mentioned in the first paragraph above must be provided in each of the following cases:

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

Said proof must cover:

- all system life of the system;
- all stabilised and transitional phases encountered.

3. The proof must concern:

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

b) demonstration of launcher reliability within this envelope, in particular:

- proof of its mechanical strength (propulsion systems, main structures and subsystem);
- proof of the performance of the propulsion and pyrotechnical systems;
- proof of 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) mechanical characterisation specific to the launcher break-up studies:

- determination of the minimum value in terms of incidence and dynamic pressure guaranteeing structural break-up;
- determination of 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) the following analyses concerning ground operations:

- analysis of the chronology of the launch operation, demonstrating that the expected status is reached at the irreversible moment;
- analysis of 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 man or remotely via an instrumentation and control system.

Article 17 – Specific mission analysis

In addition to the proof specified in article 16 of this order, relating to generic justification of the launch system for a given mission family, the launch operator must furnish the following, elements inherent in the planned operation:

1. demonstration of compliance with the operating envelope of the launch vehicle;

2. demonstration of the compatibility of the objects intended to be placed in orbit with the launch vehicle environments (geometrical, mechanical, dynamic, thermal, electromagnetic and radioelectric);

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

4. demonstration that the actual characteristics of the specific launcher used for the mission are in conformity with the theoretical definition presented in compliance with article 16 of this order;

5. as applicable, proof that the deviations (anomalies, evolutions) in relation to the configuration which was licensed, in accordance with the requirements of article 16 of this order (definition, production process, implementation) and those resulting from

utilisation of the parameters recorded in-flight, are analysed and made technically acceptable;

6. proof of the specific mission trajectory, optimised with respect to the potential hazards;

7. definition of the flight corridor around the nominal trajectory, up to orbital injection;

8. the sizing and position of the fall-back zones for the elements not placed in orbit, including with regard to notification of air and maritime traffic;

9. definition of the end-of-life choices for the elements placed in 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;

10. validation of the customized parameters for flight control and the flight software, tailored to the mission, such as to be able to furnish proof of correct working of the flight software;

11. with regard to the launch vehicle on-board automatic neutralisation systems, as applicable:

    - definition of the settings based on analysis of simulated non-nominal trajectories;

    - sizing and positioning of the fall-back zones following neutralisation;

    - validation of the flight software specific algorithm thresholds allowing neutralisation of the launch vehicle, in order to demonstrate correct operation.

Article 18 – On-board neutralisation systems

<u>For the launch phase</u>:

An exhaustive study of the failure scenarios at the origin of abnormal situations leading the launch vehicle to become a hazard must be carried out by the launch operator, in particular in the following cases:

- deviation from the predetermined flight corridor,
- dangerous fall-back of elements designed to separate,
- non-nominal behaviour of flight control,
- failure to place the upper composite into orbit.

This study must give qualitative and quantitative proof of the need or otherwise for on-board automatic systems in order to neutralise the launch vehicle before the moment at which the impact zone is tangent to the territorial waters of the first State encountered along the nominal trajectory. If such resources prove to be necessary, this study must define them as well as the elements required by article 17 of this order.

For controlled re-entry:

An exhaustive study of the failure scenarios at the origin of abnormal situations leading for the propulsion element of the launcher placed in orbit to become a hazard must be carried out by the launch operator, in particular in the case of failure to control the level or direction of thrust.

This study must present the on-board automatic systems for ensuring controlled re-entry of the propulsion element placed in orbit.

Article 19 – Flight tracking and associated experience feedback

The launch vehicle operating parameters, including its positions and speeds, which have an impact on risk management as resulting from the studies mentioned in articles 7 and 8 of this order must 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 must be subsequently analysed for any recurring launch system.

Sub-section 2 – Quantitative objectives for human safety

Article 20 – Quantitative objectives for human safety

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

a) Lift-off risk

- $2*10^{-5}$ for the entire launch phase, including consideration of degraded launch system situations and fall-back of elements designed to separate from the launcher without being placed in orbit,
- 10^{-7} by nominal fall-back of those elements designed to separate from the launcher without being placed in orbit, in accordance with paragraph 1 of article 23 of this order.

b) Re-entry risk

- $2*10^{-5}$ for the return phase of each launcher element placed in orbit, in a controlled atmospheric re-entry, including – in accordance with 1 of article 23 of this order – a specific allocation of 10^{-7} for nominal return of the element. The launch operator implements this controlled re-entry in accordance with paragraphs 1 and 5 of article 21 of this order.
- If the impossibility of a controlled atmospheric re-entry as specified above can be duly proven, the launch operator must do it its best efforts to meet a quantitative objective of 10^{-4} for the return phase of each launch element placed in orbit. In this case, the choice of the architecture and materials of the elements placed in orbit and subject to uncontrolled re-entry must be justified with respect to the objective of limiting the number and energy (kinetic and explosive) of the fragments liable to reach the ground.

2. the requirements mentioned in the first paragraph above must 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 in orbit);
- 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 re-entry or at neutralisation of the launch vehicle;
- dispersion of debris on the ground and evaluation of their effects;
- launcher reliability for the launch phase;
- the reliability of the de-orbiting manoeuvre for the launcher propulsion element placed in orbit, in the case of controlled re-entry.

3. Specific quantitative allocations for a risk of particular catastrophic damage may be specified, in compliance with the objectives mentioned in the first paragraph of this article, in accordance with article 5 of the above-mentioned decree of 9th June 2009.

Sub-section 3 –Space debris limitation and prevention of collision risks

Article 21 –Space debris limitation

The launch system implemented by the launch operator must be designed, produced and implemented such as to comply with the following requirements for the elements operating in extra-atmospheric space:

1. The launcher must 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 takes the following measures in this respect:

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

The above requirements do not apply:

- to pyrotechnic systems. The largest dimension of any products generated must be less than 1 mm;
- to solid propellant boosters. The size of any combustion debris generated in protected region B must be less than 1 mm. With regard to the design and operation of solid propellant boosters, the launch operator takes steps to avoid placing solid combustion products in long-term orbit which could contaminate protected region A.

2. The launcher must 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 must be less than 10^{-3} until the end-of-life of the space object. This calculation must include failure modes of propulsion and power systems, mechanisms and structures but does not take account of any external impacts.

Intentional fragmentations of launcher elements are prohibited.

4. The launcher must be designed, produced and implemented so that, following the disposal phase:

- all the on-board energy reserves are permanently depleted or placed in a state such that depletion of the on-board energy reserves is inevitable, or in such a condition that they entail no risk of generating debris;
- all the means for producing energy production means are permanently deactivated.

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

If the impossibility of meeting this requirement can be duly proven, the launcher must 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 is preferably achieved by uncontrolled atmospheric re-entry or, failing that by placing them to an orbit for which the perigee remains above protected region A for one hundred years following the end of the operation.

6. The launcher must 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 must be such that, under the effect of natural disturbances, the launcher or its components do not return to protected region B within one hundred years following the end of the operation.

7. The probability of successfully completing the disposal manoeuvres mentioned in paragraphs 4, 5 and 6 above must 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, must take account of all the systems, subsystems and equipment usable for these manoeuvres, their redundancy levels as applicable and their reliability, taking account of the effects of the ageing reached at the time for which their use is scheduled, along with the availability of the means and energy resources necessary for these manoeuvres.

Article 22 – Prevention of risks of collision

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

Sub-section 4 – Requirements related to fall-back to Earth

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 the propulsion element placed in orbit for controlled atmospheric re-entry, the fall-back zone on Earth

must be controlled by the launch operator. The fall-back zone, associated with a probability of 99.999%, must not impinge on the territory, including the territorial waters, 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 operating dispersions of the launch vehicle subsystems;
- modelling of the scenarios covering fragmentation and the corresponding generation of debris;
- analysis of dispersion of the debris falling on the sea.

2. In the event of a fall-back zone being situated in a region with heavy maritime traffic (mainly shipping lanes) or in which fixed and manned oil platforms are located, a special analysis must be carried out to deal with the hazards described in article 7 of this order.

3. The organisation and resources put into place by the launch operator must enable the President of the Centre national d'études spatiales or the Minister with responsibility for space:

- 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;
- without delay 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 non-nominal 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 24– Wrecks and recovery of launcher elements

1. All launchers must be designed, produced and implemented so that the propulsion stages designed to fall back to Earth do not constitute a technical hazard following the creation of a maritime wreck. Wrecks must not constitute or threaten to constitute an obstacle or hazard for navigation, fishing, or the environment, or a shipping hazard or obstacle in a port, approach channel or road.

2. When the stages are to be recovered, their neutralisation system must be inhibited in the event of nominal separation, but must function in the event of uncommanded separation or stage break-up. It must be possible to make this system safe before any recovery operation.

Sub-section 5 – Particular hazards

Article 25 – Nuclear safety

Any launch operator intending to transport radioactive materials on-board the launch vehicle conforms to the applicable regulation in force and demonstrates application thereof in the nuclear safety plan required in II.2°d) of article 1 of the above-mentioned decree of 9th June 2009.

Article 26 – Planetary protection

Any launch operator conducting a launch to another celestial body, whether or not including the return of extraterrestrial materials, must 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 and demonstrate application thereof in the planetary protection plan required in II.2°d) of article 1 of the above-mentioned decree of 9th June 2009.

Chapter 4 – Technical requirements concerning the launch site

Article 27

1. For operations run from the Guiana Space Centre, the launcher must be designed and produced to ensure compatibility with the systems and procedures contained in the order constituting the special policing regulation issued by the President of the Centre national d'études spatiales.

2. For operations run from another launch site and subject to the waivers granted under article 4.4 of the above-mentioned Act of 3rd June 2008, the operator:

- furnishes proof of the existence of the systems and procedures specific to said site, in particular concerning positioning, neutralisation and telemetry, designed to protect individuals, property, public health and the environment during the course of the operation;
- furnishes proof of the compatibility of the above-mentioned systems and procedures with the requirements of this order;
- demonstrates that the launcher is designed and produced to ensure compatibility with the above-mentioned systems and procedures.

PART THREE
CONTROL AND RETURN TO EARTH OF A SPACE OBJECT

SECTION I

SCOPE

Article 28

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.

PART II

TECHNICAL FILE

Chapter 1 – Documentation to be provided

Article 29 – Description of the space operation and associated systems and procedures

The description of the space operation and the implemented systems and procedures as mentioned in II.1° of article 1 of the above-mentioned decree of 9th June 2009 presents the space system used for the planned operation, consisting of the ground segment and the space object. This description also presents the various subsystems of said object.

When dealing with space object performing re-entry at end of life, the description presents the platform and payload components, as well as their equipment, able to reach the ground, stating the dimensions, masses and materials used.

This description comprises a mission analysis presenting the reference orbit, the means of attaining it (injection, station acquisition) and maintaining it (station-keeping) with the associated space and time coordinates, the measures for reconstructing the orbit with the intended degree of precision, the ability to control the object (existence and visibility of ground stations or relay satellites, of the control centre or on-board autonomous capability), as well as the disposal strategy. It states the space system models used to perform this mission analysis.

This description comprises the control capability covered by article 39 of this order.

Article 30 – General notice of conformity

1. In accordance with II.2°a) of article 1 of the above-mentioned decree of 9th June 2009, the operator establishes a general notice of conformity with these technical regulation.

2. This general notice of conformity:

- identifies the documents supplied under articles 31 to 34 and 47 and 48 of this order;
- establishes the resulting status of conformity.

Article 31 – Internal standards and quality management provisions

In accordance with II.2°b) of article 1 of the above-mentioned decree of 9th June 2009, the operator produces documents proving compliance with the requirements of chapter 2 of this section.

Article 32 – Hazard study

In accordance with II.2°c) of article 1 of the above-mentioned decree of 9th June 2009, the operator carries out a study of the potential hazards of the planned space operation for individuals, property, the environment and public health, in particular hazards related to the generation of space debris.

This study includes a description of all the hazards relating to the operation in the case of both nominal and accidental operating situations, whether the cause is internal or external in nature, and specifies the nature and scope of the consequences.

This study must in particular cover the following events, in the conditions laid out in chapters 3 and 4 of this section:

- human injury caused by a re-entry to Earth,
- production of space debris following an explosion,
- collision with a manned space object,
- injection in a degraded orbit leading to premature re-entry,
- collision with a satellite in geostationary orbit, whose orbital parameters are precisely known and available, during station acquisition, repositioning or disposal manoeuvres,
- dispersion of radioactive material,
- planetary contamination.

The contents of the hazards study must be commensurate with the severity and probability of occurrence of the critical events liable to be caused by the planned operation.

Article 33 – Impact assessment

In accordance with II.2°d) of article 1 of the above-mentioned decree of 9th June 2009, the operator carries out an assessment of the impact of the planned operation on the Earth's environment, as well as the impact in terms of generation of space debris, in compliance with the provisions of article 40 of this order.

This impact assessment, for nominal operation, identifies and evaluates the environmental impacts of the operation and the measures taken to mitigate any negative impacts. This impact assessment in particular identifies debris created or liable to be created by deployment of the space object. The content of this impact assessment must be commensurate with the foreseeable incidence and the direct or indirect, temporary or permanent effects of the planned operation on the environment.

Article 34 – Risk management measures

In accordance with II.2°e) of article 1 of the above-mentioned decree of 9th June 2009, and on the basis of the conclusions of the hazard study and impact assessment mentioned in articles 32 and 33 above, the operator draws up and implements the following risk management plans:

- the space debris limitation plan, demonstrating compliance with the requirements of article 40 of this order;

- the environmental damage prevention plan, demonstrating that the materials and energy sources chosen for the space object are not such as to create environmental damage, as well as compliance with paragraph 2 of article 45;

- the prevention plan concerning hazards resulting from the fall-back of a space object or fragments thereof, demonstrating compliance with the provisions of articles 44 to 46 of this order;

- the prevention plan concerning the risks of collision, demonstrating compliance with the requirements of article 41 of this order;

- as applicable, the nuclear safety plan, demonstrating compliance with the requirements of article 42 of this order;

- as applicable, the planetary protection plan, demonstrating compliance with the requirements of article 43 of this order.

Chapter 2 – Quality system requirements

Article 35 – Competence, resources, organisation and installations

1. For performance of the space operation, the operator must implement and manage a quality management system as well as internal standards and quality management provisions in conformity with article 1 of the above-mentioned decree of 9th June 2009. This management system must cover quality assurance, dependability and safety, configuration management and supervision of work.

2. It must have the competence, resources and organisation necessary for preparing and implementing the planned operation:

- appropriate installations and organisation,
- equipment and tools and material 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.

3. The description and justification of the critical components of the space object with regard to protection of individuals, property, the environment and public health, in particular with regard to the production of space debris, and the definition of the materials used, must be kept until the end of the space operation concerned. After the disposal manoeuvres, these elements are sent to the Centre national d’études spatiales with a description of the state attained.

Article 36 – Technical and organisational events

The operator must 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 liable to affect the conditions of the space operation as authorised, in particular the disposal strategy;

- as specified in article 7 of the above-mentioned decree of 9th June 2009, to inform the Centre national d'études spatiales without delay of all these technical and organisational events.

Article 37 – Technical reviews

Key points defined to check implementation of the provisions of this order must be scheduled by the operator. The operator must inform the Centre national d'études spatiales of the key points prior to launch and to initiation of the space object disposal manoeuvres.

Article 38 – Co-contractors and subcontractors

1. The operator must ensure that its co-contractors and subcontractors apply all the measures necessary for establishing and maintaining conformity with these technical regulation.

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

Chapter 3 – Specific technical requirements common to control in orbit and return to Earth of a space object

Article 39 – Ability to control the space object

The object must be designed, produced and implemented in such a way that the operator, for the duration of the operation, can receive information about its status and send it commands, in particular those necessary for implementation of articles 47 and 48 of this order.

Article 40 –Space debris limitation

The systems implemented by the operator must be designed, produced and implemented such as to comply with the following requirements:

1. The systems must be designed, produced and implemented so as to avoid generating debris during nominal operations of the space object.

The above requirement does not apply:

- to pyrotechnic systems. The largest dimension of any products they generate must however be less than 1 mm;
- to solid propellant boosters. The size of any combustion debris they generate in protected region B must however be less than 1 mm. With regard to the design and operation of solid

propellant boosters, the operator implements measures allowing to avoid placing durably in orbit solid combustion products which could contaminate protected region A.

2. The probability of occurrence of accidental break-up must be less than 10^{-3} until the end of life of the space object. This calculation must include failure modes of propulsion and power systems, mechanisms and structures, but does not take into account external impacts.

If a situation leading to such a failure is detected, the operator must be able to schedule and implement corrective measures to prevent any break-up.

3. The systems must be designed, produced and implemented so that, following the disposal phase:

- all the on-board energy reserves are permanently depleted or placed in such a condition that they entail no risk of generating debris,
- all the means for producing energy on-board are permanently deactivated.

4. The systems must be designed, produced and implemented so that, once the space object has completed its operational phase in an orbit passing through protected region A, the space object is de-orbited with controlled atmospheric re-entry.

If the impossibility of meeting this requirement can be duly proven, it must be designed, produced and implemented so that it is no longer present in protected region A twenty-five years after the end of the operational phase. This result is preferably achieved by uncontrolled atmospheric re-entry or, failing that, by placing in a stable orbit for which the perigee remains above protected region A for one hundred years following the end of the operation.

5. The space object must be designed, produced and implemented so that, once it has completed its operational phase in an orbit in or passing through protected region B, it is placed in an orbit which does not interfere with this region. This orbit must be such that, under the effect of natural disturbances, the object does not return to protected region B within one hundred years following the end of the operation.

6. The probability of having sufficient energy resources to successfully carry out the disposal manoeuvres mentioned in paragraphs 3, 4 and 5 above must be at least 0.9.

7. The operator must evaluate the probability of being able to successfully carry out the disposal manoeuvres mentioned in paragraphs 3, 4 and 5 above. This evaluation, which does not include the availability of energy resources, must be made by the operator for the total duration of the operation and take account of all systems, subsystems and equipments usable for these manoeuvres, their level of redundancy, if any, and their reliability, taking account of the effects of the ageing reached at the time they are scheduled to be carried out.

Article 41 – Prevention of risks of collision

The systems must be designed, produced and implemented and their mission defined so that during the space operation and the three days following the end of the operation, the risks of accidental collision with manned objects and satellites in geostationary orbit for which the orbital parameters are precisely known and available is limited.

Article 42 – Nuclear safety

Any operator intending to utilise radioactive materials on-board the space object conforms to the applicable regulation in force and demonstrates application thereof in the nuclear safety plan required in article 1 of the above-mentioned decree of 9th June 2009.

Article 43 – Planetary protection

Any operator intending to conduct a mission to another celestial body, whether or not including the return of extraterrestrial materials, must 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 demonstrates implementation thereof in the planetary protection plan required by article 1 of the above-mentioned decree of 9th June 2009.

Chapter 4 – Specific technical requirements for the return of a space object

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

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) are defined as follows:

- $2*10^{-5}$ for return of an integral object;
- $2*10^{-5}$ for controlled atmospheric re-entry with destruction of the space object;
- If it can be duly proven that controlled atmospheric re-entry with destruction of the space object as mentioned above is impossible, the operator must do its best efforts to meet a quantitative objective of 10^{-4} for uncontrolled re-entry with destruction of the space object.

2. The provisions mentioned in the first paragraph above must be evaluated using a calculation method based on:

- consideration of all phenomena leading to a risk of catastrophic damage;
- consideration of the trajectories before fragmentation;
- modelling of the fragmentation and debris generation scenarios corresponding to re-entry;
- dispersion of the debris on the ground and evaluation of their effects;
- consideration of the reliability of the space object.

3. These objectives comprise the risk associated with 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 an end-of-life space object

1. The choice of architecture and materials of the space objects undergoing uncontrolled re-entry must be justified with the aim of limiting the number and energy (kinetic and explosive) of the fragments liable to reach the ground.

2. The systems must be designed, produced and implemented so that the elements which manage to reach the surface of the Earth entail no unacceptable risk for individuals, 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 controlled re-entry

1. The operator determines 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 must take account of the uncertainties linked to the re-entry parameters.

2. The fall-back zone associated with a probability of 99.999% should 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 traffic (mainly shipping lanes) or in which fixed and manned oil platforms are located, a special analysis must be carried out within the hazards study described in article 32 of this order.

3. The organisation and resources put into place by the operator must enable the President of the Centre national d'études spatiales:

- 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 in any non-nominal situation, so that the authorities of the states concerned can be warned as early as possible;
- to provide all useful information at its disposal so that the necessary response plans can be determined and implemented by the competent authorities.

SECTION III

OBLIGATIONS RELATED TO PERFORMANCE OF THE SPACE OPERATION

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.

Article 48 – Status of the space object

1. The operator keeps an up-to-date status demonstrating the ability of the space object to perform the disposal manoeuvres specified in paragraphs 3, 4 and 5 of article 40 of this order and in particular the availability of the energy resources needed for this manoeuvres. This status is transmitted to the Centre national d'études spatiales whenever an event affecting this capacity occurs.

2. The space object status attained following the disposal operations will be transmitted to the Centre national d'études spatiales.

Article 49 – Intentional destruction

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

2. When the operator intends to proceed with intentional destruction, it notifies the President of the Centre national d'études spatiales 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.

PART FOUR
PRELIMINARY CONFORMITY WITH THE TECHNICAL REGULATION

SECTION I

SCOPE

Article 50

Under article 11 of the above-mentioned decree of 9th June 2009, the following critical systems and subsystems may be submitted to the Centre national d'études spatiales:

- the space system;
- the space object;
- the space object platform, associated with a monitoring and controlling system as applicable;
- the propulsion subsystem of a space object;
- the launch installations of a space object.

Article 51

The file stipulated in the first paragraph of article 11 of the above-mentioned decree of 9th June 2009 is created in accordance with the requirements of article 50 of this order. It is submitted to the Centre national d'études spatiales during development of the system or subsystem concerned, and no earlier than the end of the preliminary design phase.

The document certifying preliminary conformity with these technical regulation may be issued by the Centre national d'études spatiales following the following design and development steps of the system or subsystems:

- 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.

SECTION II

PROCEDURE FOR ISSUE OF THE DOCUMENT CERTIFYING CONFORMITY

Article 52 – Documents to be provided

1. For a launch system, and depending on the system concerned, the bidder supplies all or some of the documents specified in articles 4 to 10 of this order.

For a launch system propulsion subsystem, the Centre national d'études spatiales draws up the list of documents to be supplied and the associated schedule, after supplying the development plan stipulated in the first paragraph of article 11 of the above-mentioned decree of 9th June 2009.

2. For a space system other than a launch system, and depending on the system concerned, the bidder supplies all or part of the documents stipulated in articles 29 to 34 of this order.

Article 53 – Checks, tests and analyses

On the basis of the items supplied pursuant to article 52 of this order, the Centre national d'études spatiales specifies all the checks, tests and analyses as provided for in the second paragraph of article 11 of the above-mentioned decree of 9th June 2009.

With regard to a launch system, these requests can 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 section

Article 54

1. A guide of good practices is drawn up by the Centre national d'études spatiales, jointly with the profession, through a working group representative of the operators and industrial firms concerned, in order to characterise certain practices in force, that help to demonstrate compliance with these technical regulation.

This guide is based on practices validated by the experience acquired in the development, operation and inspection of space systems. It is 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 this guide comply with the applicable requirements for protection of intellectual property as well as industrial and scientific assets.

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

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

PART SIX
INTERIM AND FINAL PROVISIONS

Article 55 – Interim provisions

1. For space object launch operations, the following interim provisions are implemented:

a) The authorization application files for launch operations using a launch system which was operated for the first time from French territory before 4th June 2008 can refer to the technical files already examined by the Centre national d'études spatiales, in particular within the framework of existing international agreements, especially those concluded with or through the European Space Agency.

In this case, the requirements of paragraph 6 of article 21 of this order do not apply. If it can be duly proven that the requirements of paragraph 5 of article 21 of this order cannot be implemented, the launch operator will do everything it can to approach the thresholds mentioned.

b) Concerning systems for which the first launch from French territory takes place between 4th June 2008 and 31st December 2011, the requirements of paragraph 6 of article 21 of this order do not apply;

c) Concerning systems for which the first launch from French territory takes place after 31st December 2011, the requirements of this order apply in full.

2. Concerning space object control and return operations, the following interim provisions apply:

a) For space objects launched before 10th December 2010:

- with regard to the provisions of articles 32 and 33, the studies will only concern the hazards and impacts associated with the procedures implemented subsequent to 10th December 2010;
- the provisions of article 38, those of paragraphs 1, 2, 6 and 7 of article 40 and those of article 45 do not apply;
- with regard to the provisions of paragraphs 3, 4 and 5 of article 40 and those of article 41, the operator must implement the best possible strategy considering the space object definition;
- with regard to the provisions of article 44, the operator must implement the best possible strategy considering the space object definition and must perform a risk estimate.

b) For space objects launched between 10th December 2010 and 31st December 2020:

- the provisions of paragraphs 1 to 2 of article 40 and those of article 45 do not apply;
- with regard to the provisions of paragraph 3 to 6 of article 40 and those of article 41, the operator must implement the best possible strategy considering the space object definition;
- with regard to the provisions of article 44, the operator must implement the best possible strategy considering the space object definition and must perform a risk estimate.

Article 56

The Director General for Research and Innovation is responsible for the execution of this order, which will be published in the Official Gazette of the French Republic.