Guidelines on License Related to Control of Spacecraft

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Cabinet Office
National Space Policy Secretariat

History of revisions

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First Edition	November 15, 2017	New establishment
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Table of Content

1. Introduction

These Guidelines are intended to provide guidance to the concept of compliance and specific examples related to the review standards on license related to control of spacecraft as provided in the Review Standards and Standard Processing Relating to Procedures under the Act on Launching of Spacecraft, etc. and Control of Spacecraft.

For the development of these Guidelines, domestic and foreign standards (e.g. ISO, IADC Guidelines, FAA standards) were consulted with.

2. Governing documents

For these governing documents, consult with the latest versions as of the time of application.

(1) Act on Launching of Spacecraft, etc. and Control of Spacecraft (Act No. 76 of 2016)

(2) Regulation for Enforcement of the Act on Launching of Spacecraft, etc. and Control of Spacecraft (Cabinet Office Order No. 50 of 2017)

(3) Review Standards and Standard Processing Relating to Procedures under the Act on Launching of Spacecraft, etc. and Control of Spacecraft

3. Definitions of terms

Unless otherwise provided, the terms used in these Guidelines have the meanings as defined in the Act and Regulation. The terms and abbreviations as used in these Guidelines have the following meanings:

- Act
  Act on Launching of Spacecraft, etc. and Control of Spacecraft (Act No. 76 of 2016)

- Regulation
  Regulation for Enforcement of the Act on Launching of Spacecraft, etc. and Control of Spacecraft (Cabinet Office Order No. 50 of 2017)

- Review Standards
  Review Standards and Standard Processing Relating to Procedures under the Act on Launching of Spacecraft, etc. and Control of Spacecraft

- Spacecraft
  An artificial object which is used by putting it into Earth orbit or beyond or placed on a celestial body other than the Earth. More concretely, a spacecraft means an earth orbiting spacecraft including an earth observatory satellite and positioning satellite, a geostationary satellite, an explorer navigating in outer space including the area beyond a geostationary orbit, an explorer engaged in activities in the vicinity or on the ground surface or other celestial body (e.g. rover), reentry vehicle and dummy mass.

- Spacecraft, etc.
  A spacecraft and a vehicle for launching a spacecraft

- Launch of spacecraft, etc.
  Loading a spacecraft onto a launch vehicle, lifting off and accelerating the launch vehicle until it reaches a certain speed and altitude, and separating the spacecraft at that point, using a launch site managed and operated by the person or another person.

- Low earth orbit protected region
  A spherical region that extends from the Earth's surface up to an altitude of 2,000 km

- Geostationary earth orbit protected region
  A region of spherical shell which is defined as follows:
  - Lower altitude = geostationary altitude (approximately 35,786km) minus 200km
  - Upper altitude = geostationary altitude plus 200km
  - -15 degrees ≤ latitude ≤ +15 degrees

- Expected casualties (Ec)
  A probabilistic prediction of number of people that may be seriously affected by contact with falling objects, etc. such as the loss of human life or long-term disability or loss of body function.

- Radio equipment
  Electrical equipment for transmitting or receiving codes using electromagnetic

waves, and a computer connected to the equipment via telecommunication lines

- Spacecraft control facility
  Radio equipment equipped with functions to detect a signal indicating the position, attitude and condition of a spacecraft transmitted by spacecraft-borne radio equipment either directly or by receiving it via other radio equipment using electromagnetic waves, or to detect the position of the spacecraft by transmitting a signal to the spacecraft either directly or via other radio equipment and then receiving the reflected signal from the spacecraft directly or via other radio equipment, or by other means, and to transmit a signal to control the position, attitude and condition of the spacecraft to the spacecraft-borne radio equipment directly or via other radio equipment using electromagnetic waves

- Control of spacecraft
  To detect the position, attitude and condition of a spacecraft and control it using a spacecraft control facility (the control of any of position, attitude or condition is applicable).

- Manned spacecraft, etc.
  A space station including an international space station and a manned spacecraft.

- COSPAR
  Committee on Space Research

- IADC
  Inter-Agency Space Debris Coordination Committee

- ISO
  International Organization for Standardization

- FAA
  Federal Aviation Administration

- JSpOC
  Joint Space Operations Center

- Controlled reentry
  A reentry whereby a spacecraft, etc. is controlled to fall to the landing point, water landing point or area where the measures to ensure safety have been taken in advance.

4. Scope of Application

A person who intends to implement the control of a spacecraft using a spacecraft control facility located in Japan (including the control in Japan through a ground station located outside Japan) is required to obtain a license related to the control of a spacecraft, even if the spacecraft is launched outside Japan. In addition, even if a spacecraft control facility for normal operation is located outside Japan, the license is required if the control of a spacecraft is to be implemented using a spacecraft control facility located in Japan for any phase including initial operation.
A prior consultation with the National Space Policy Secretariat of the Cabinet Office of Japan (hereinafter referred to as the "NSPS") is recommended in case where the applicant is unable to determine whether the license is necessary.
This license does not cover the control of a spacecraft currently implemented at the time of the full enforcement of the Act. "Control of a spacecraft currently implemented" generally means that the control has been already commenced on the orbit (including the case of commencement of the control of a spacecraft only using a spacecraft control facility located outside Japan).

5. Outline of process (from application to grant of license)

5.1. Application process

An applicant is recommended to hold a prior discussion with the NSPS from the preparation stage of the application, so as to avoid any duplicated procedures. Officials of the NSPS may enter the offices, etc. of the applicant and conduct a verification, etc. as deemed necessary for facilitating the review.

5.2. Standard period of time for process

15 days - 3 months
The standard period of time for process is the length of time generally required for processing an application without any defect in the application documents.

An applicant may file an application or seek a prior consultation any time. An applicant is recommended to submit an application allowing for sufficient time

before the slated time for the commencement of the control of spacecraft. The time for the commencement of the control of spacecraft generally means the time when the spacecraft is separated from the launch vehicle.

In the case of an application for license related to the control of spacecraft that proved to be appropriate in the past, for example, the applicant obtained a license relating to the control of the same spacecraft including a constellation in the past, it is highly possible that the time required for the review will be accelerated. In order to prepare application documents in an effective way, the applicant is recommended to consult with the NSPS in advance.

6. License related to control of spacecraft

6.1. Purpose and method of using the spacecraft

Article 22 of the Act (Requirements for License)

(i) the purposes and methods of use of the spacecraft are in compliance with the basic principles, and are not likely to cause any adverse effect on the accurate and smooth implementation of the conventions on development and use of outer space and the ensuring of public safety;

Review Standards

- The purposes and methods of use of the spacecraft are in compliance with the basic principles (Articles 2 through 7 of the Space Basic Act).
- The purposes and methods of use of the spacecraft are not likely to cause any adverse effect on the accurate and smooth implementation of the conventions on development and use of outer space and ensuring public safety.

- The purposes and methods of use of the spacecraft are in compliance with the basic principles (Articles 2 through 7 of the Space Basic Act).

Space Basic Act

Article 2 (Peaceful Use of Outer Space)

Space Development and Use shall be carried out in accordance with treaties and other international agreements with regard to Space Development and Use including the Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies, in accordance with the pacifism of the Constitution of Japan.

Article 3 (Improvement of Lives of the Citizenry, etc.)
Space Development and Use shall be carried out in order to improve the lives of the citizenry; to ensure a safe and secure society; to mitigate disasters, poverty and various other threats to the survival and lives of humankind; to ensure international peace and security; and to increase the national security of Japan.

Article 4 (Advancement of Industries)
Space Development and Use shall be carried out in order to strengthen the technical capabilities and international competitiveness of the space industry and other industries of Japan, thereby contributing to the advancement of the industries of Japan, by the positive and systematic promotion of Space Development and Use as well as smooth privatization of the results of the research and development with regard to Space Development and Use.

Article 5 (Development of Human Society)
Space Development and Use shall be carried out in order to contribute to the realization of the aspiration of humankind and the development of human society, by promoting state-of-the-art Space Development and Use as well as advancing space science, in consideration of the fact that the aggregate knowledge of space is an intellectual asset of humankind.

Article 6 (International Cooperation, etc.)
Space Development and Use shall be carried out in order to enable Japan to play a positive role and contribute to advancing national interests in international society, through positively promoting international cooperation and diplomacy with regard to Space Development and Use.

Article 7 (Due Consideration for Environment)
Space Development and Use shall be carried out with due consideration concerning the influence of Space Development and Use upon the environment.

It is necessary that the purposes and methods of use of the spacecraft are not likely to cause any adverse effect on the accurate and smooth implementation of the conventions on development and use of outer space and ensuring public safety (including the safety of manned spacecraft, etc.)

For example, a spacecraft loading weapons of mass destruction and a spacecraft for conducting an act of terrorism does not satisfy the criteria for license.

6.2. Configuration of spacecraft

Article 22 of the Act (Requirements for License)

(ii) the configuration of the spacecraft, a mechanism for the prevention of dispersion of its components and parts has been implemented, or that the configuration of the spacecraft otherwise complies with the standard specified by Cabinet Office Order as being those that are not likely to cause an adverse effect on the prevention of the harmful contamination of outer space including the Moon and other celestial bodies and the prevention of potentially harmful interference with activities of other countries in the peaceful exploration and use of outer space provided in Article 9 of the Outer Space Treaty (referred to as "harmful contamination of outer space, etc." in the following item and item (iv)(d)) and the ensuring of public safety;

6.2.1. Prevention of unintended release of objects

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(i) that a mechanism has been implemented to prevent the dispersion of components and parts of the spacecraft (hereinafter referred to as "components, etc.");

Review Standards

1. Prevention of unintended release of objects

- The spacecraft has a configuration to prevent the components, etc. from coming off or scattering easily.
- The spacecraft has a configuration to prevent components, etc. from scattering easily upon the operation of the separation or deployment system, etc. of the spacecraft.
- Due consideration is paid to the configuration so as to minimize the release of combustion products generated from pyrotechnics, etc.

The following measures must be taken to prevent scattering of components, etc. of the spacecraft.

(1) The spacecraft must have a configuration to prevent components, etc. from coming off or scatter easily.
    - The spacecraft must have a certain level of strength to prevent the separation and scattering of an antenna, solar array panels, etc. during the normal

operation, for example, strength in relation to the normal launch environment of spacecraft, etc.

(2) Take measures so that the components, etc. will not come off easily upon the operation of the separation or deployment mechanisms of the spacecraft. However, this does not apply to the case where separation and deployment mechanisms, etc. are not to be operated during the period of control of the spacecraft.

- For example, take measures such as a separation method without cutting with pyrotechnic devices bolt, etc., a bolt catcher to prevent release of fasteners etc. upon deployment of an antenna and solar array paddles, etc. and a melting method considering the structures and configuration such that melted fiber will not scatter easily.

(3) Take the following measures in relation to combustion products generated by pyrotechnic devices, etc. However, this does not apply to a spacecraft not using any pyrotechnic devices, etc. during the period of control of the spacecraft.

- For the release of the combustion products of pyrotechnic devices, combustion products larger than 1mm in their largest dimension must not be released into the Earth orbit.
- Take the following measures in relation to a solid motor:
  - Measures to avoid releasing solid combustion products in the geostationary earth orbit protected region.
  - Measures considering the prevention of the release of solid combustion products that may contaminate the low earth orbit protected region.

6.2.2. Prevention of interference to the control of other spacecraft upon separation or docking

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(ii) in the case of a configuration separating the components or parts of the spacecraft, or a configuration docking the spacecraft with other spacecraft, etc., that a mechanism has been implemented to prevent it from causing any adverse effect on the control of other spacecraft;

Review Standards

2. Prevention of interference with the control of other spacecraft upon separation or

docking
- The spacecraft has a configuration enabling it to be put into an appropriate orbit in a manner not having a severe adverse effect on the control of other spacecraft, including a manned spacecraft, upon the separation of components or parts of the spacecraft.
- The spacecraft has a configuration enabling it to be docked with another spacecraft, etc. without the separation or release of components, etc. so as not to have any severe adverse effect on the control of other spacecraft.

- If the spacecraft performs the planned release of components, etc. constituting the spacecraft systematically (including the case where a slave spacecraft is separated from a master spacecraft), indicate that the separated objects would not give any severe adverse effect on other spacecraft including manned spacecraft, etc., by assessing collision probability based on properties of the separated object such as cross section to mass ratio orbital lifetime, etc. In cases where the separated component, etc. is also controlled as a spacecraft, a separate application for license related to the control of spacecraft is required.
- If a docking to other spacecraft, etc. or capturing of debris is to be executed, indicate that the spacecraft has a configuration to prevent the generation of fragments by the collision upon docking. In cases where fragments may be generated by collision upon docking, their impact on spacecraft other than the spacecraft to be docked is be analyzed, and indicate that it does not give any severe adverse effect on control of the spacecraft.

6.2.3. Prevention of break-up upon the occurrence of anomalies

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(iii) that a mechanism has been implemented to prevent the break-up of the spacecraft in the case of detecting any anomaly in the position, attitude and condition of the spacecraft;

Review Standards

3. Prevention of break-up in case of anomalies
- The spacecraft has a configuration to enable it to transmit signals indicating its position, attitude and condition to the spacecraft control facility directly or via other radio equipment.
- The spacecraft has a configuration enabling the prevention of break-up, such as the

venting of residual energy including residual propellant and electricity which may cause the break-up of the spacecraft.

- The spacecraft must be equipped with a function of transmitting its position, attitude and condition to the spacecraft control facility. This also applies in the case of identifying the position by receiving and processing at the spacecraft a signal transmitted from the spacecraft control facility and transmitting the signal to the spacecraft control facility. Signals transmitted from the spacecraft may be transmitted via a spacecraft, an aircraft, a balloon, etc. In this case, describe the communication route such as the spacecraft, the aircraft, or the balloon, etc. that relays the information.
- The following measurement items must be monitored so as to detect anomalies in propulsion system or battery system that may be causes of break-up, as it is necessary to detect precautions indicating possibilities of destruction of a spacecraft and take appropriate measures. However, batteries of which internal pressure does not increase in principle, tanks or batteries that have safety valves that work accurately, or tanks or batteries having sufficient strength in structure that withstand expected maximum internal pressure are excluded.
  (1) Pressure and temperature of tanks to measure the volume of residual propellant
  (2) Temperature and voltage of terminals to monitor anomalies of batteries

- The configuration of the spacecraft must be capable of removing residual energy or to execute measures to ensure safety in anomalies (any of the means of mechanical structure, circuits, system or software is sufficient). However, batteries of which internal pressure does not increase in principle or tanks or batteries having sufficient strength in structure that withstand expected maximum internal pressure are excluded.
  (1) Measures relating to residual liquid propellant and residual high pressure fluid

  In order to prevent a break-up, specific measures such as a configuration enabling venting of residual energy, sufficient structural strength that eliminates the probability to cause break-up even considering the input heat, and measures to suppress increase of internal pressure (relief valve) can be taken.
  (2) Measures relating to batteries

A spacecraft must have configuration that enables it to permanently disconnect charging lines. If possible, measures to discharge batteries or to limit increase of internal pressure of the batteries must be taken.

6.2.4. Prevention of damages to third parties upon reentry to the Earth

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(iv) in the case of a spacecraft or its components, etc. which are to fall to Earth within or after the period of control of the spacecraft, that a mechanism has been implemented to prevent any adverse effect on the ensuring of public safety by such way as burning it in the air;

Review Standards

4. Prevention of damage to the public upon reentry into Earth

- The spacecraft or its component, etc. for reentry into Earth has a configuration to be completely ablated, or as a result of sufficient ablation, etc., the risk to the expected point of landing or water landing will not exceed the level stipulated in the international standards or standards provided by the space agency of each state.

- Indicate that spacecraft or components, etc. of spacecraft falling onto the Earth will demise completely. Or, calculate the expected casualties to be caused by objects surviving atmospheric re-entry in relation to the scheduled termination measures (i.e. controlled reentry or uncontrolled reentry), and that the value thereof does not exceed the international standard specified in the Conditions for Calculating Number of Expected Casualties and Its Methods (Spacecraft) attached to these Guidelines.
- The following matters must be taken into account for reentry survivability analysis:
  - Physical properties of reentry object (shape, size, mass, material, etc.)
  - Orbital properties at the starting point of analysis (altitude, inclination, etc.)
  - Atmospheric model

The following is the formula for the calculation of expected casualties (*Ec*).

$$E_{c-total} = \sum_{t} \sum_{j} E_{ctj}$$

$$E_{Cij} = P_{Iij}\left(\frac{N_{Pj}}{A_{Pj}}\right)\left(N_{Fi}A_{Ci}\right)$$

P_{Iij}: the probability of a fragment from debris group "i" impacting on population center "j"

A_{Ci}: the effective casualty area for a fragment from debris group "i"

N_{Fi}: the number of fragments in debris groups "i"

N_{Pj}: the number of people in population center "j"

A_{Pj}: the area of the population center "j"

Source: FAA Flight Safety Analysis Handbook ver1.0, September 2011

6.2.5. Prevention of deterioration of environment of the Earth due to substances derived from other celestial bodies

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(v) in the case of a configuration retrieving a spacecraft or its components or parts which are put into orbit around a celestial body other than the Earth or which fell to the celestial body, by guiding them to fall to Earth, that a mechanism has been implemented for the prevention of the deterioration of the environment of the Earth that may be caused by the introduction of extraterrestrial substances; and

Review Standards

5. Prevention of deterioration of the Earth's environment due to substances derived from other celestial bodies

- In the case of retrieving a spacecraft, its components or parts which were put into orbit around a celestial body other than the Earth or which fell to the celestial body, by guiding them to fall to Earth, the spacecraft has a configuration for the prevention of the deterioration of the environment of the Earth that may be caused by the introduction of extraterrestrial substances.

- In the case of a spacecraft or its components and parts which are put into orbit around a celestial body other than the Earth (including a fly-by and swing-by orbits) or which are to fall to the celestial body, retrieved by guiding them to fall onto Earth (including substances obtained from the other celestial body or attached substances derived from the other celestial body), take measures in compliance with the Planetary Protection Policy stipulated by the Committee on Space Research (COSPAR).

COSPAR Planetary Protection Policy
<https://cosparhq.cnes.fr/scientific-structure/ppp>

- Space agencies of each state have stipulated independent regulations according to the COSPAR Planetary Protection Policy. For the regulations relating to planetary protection stipulated by the space agency of each state, see the following website:
<https://planetaryprotection.nasa.gov/intpolicy>

6.2.6. Prevention of deterioration of environment of other celestial bodies

Article 22 of the Regulation (Standard Relating to Configuration of Spacecraft)

(vi) in the case of a spacecraft or its components, etc. which are put into the orbit around a celestial body other than the Earth or which are to be guided to fall to the celestial body, that a mechanism has been implemented for the prevention of the harmful contamination of the celestial body.

Review Standards

6. Prevention of contamination of environment of other celestial bodies

- In the case of a spacecraft or its components, etc. which are put into the orbit around a celestial body other than the Earth or which are to be guided to fall to the celestial body, the spacecraft has a configuration for the prevention of the harmful contamination of the celestial body.

- In the case of a spacecraft or its components and parts which are put into the orbit around a celestial body other than the Earth (including a fly-by and swing-by orbits) or which are to be guided to fall to the celestial body, take measures in compliance with the Planetary Protection Policy stipulated by the Committee on Space Research (COSPAR).

6.3. Control plan

Article 22 of the Act (Requirements for License)

(iii) the control plan requires the implementation of measures to avoid collision with other spacecraft or other measures specified by Cabinet Office Order which are necessary for the prevention of harmful contamination of outer space, etc. as well as termination measures, and the applicant (in the case of an individual,

including the representative in case of death) has sufficient ability to execute the control plan; and

6.3.1. Prevention of interference with the control of other spacecraft upon separation and docking

Article 23 of the Regulation (Measures Relating to Control of Spacecraft)

(i) measures to ensure that there will be no adverse effect on the control of other spacecraft when separating components or parts constituting the spacecraft or docking the spacecraft with other spacecraft, etc.;

Review Standards

1. Prevention of interference with the control of other spacecraft upon separation or docking

- The applicant provides measures relating to the appropriate orbital insertion to ensure that there will be no severe adverse effect on the control of other spacecraft, including manned spacecraft, when separating components or parts of the spacecraft.
- The applicant provides measures relating to the prevention of coming off or scattering of components, etc. to ensure that there will be no severe adverse effect on the control of other spacecraft when docking the spacecraft with another spacecraft, etc.

- If the applicant intends to release objects according to the plan, show the procedures to prevent the severe adverse effect on the control of other spacecraft including manned spacecraft, etc., such as the assessment of the orbital lifetime of the released objects and the surrounding orbital environment.
- If docking to other spacecraft, etc. or capturing of debris is to be executed, the impact of the docking is be analyzed, and indicate the procedures to prevent any severe adverse effect on the control of spacecraft other than the spacecraft to be docked.

6.3.2. Prevention of break-up upon the occurrence of anomalies

Article 23 of the Regulation (Measures Relating to Control of Spacecraft)

(ii) measures to ensure that a measure to prevent the break-up of the spacecraft or termination measures will be taken in the case of detecting any anomaly in the position, attitude or condition of the spacecraft;

Review Standards

2. Prevention of break-up in case of anomalies

- The applicant provides methods and guidelines for the implementation, etc. of measures to prevent break-up in cases of detecting anomalies in the condition, etc. of the spacecraft.

・ Provide for the conditions for the measures to prevent the break-up of a spacecraft or termination measures (6.4) upon detecting an anomaly in the position, attitude or condition of the spacecraft. In addition, provide for the methods for implementing measures to prevent the break-up of spacecraft, including the following:

(1) Measures related to residual liquid propellants and residual high-pressure fluid

Describe the procedure of venting or depleting the residual propellants in tanks and pipes in case of anomalies, so as to prevent the break-up. However, this does not apply to the case where the risk of break-up is eliminated by structural measures.

(2) Measures related to battery

Describe the procedures of permanent shutdown of the charging line. However, this does not apply to the case where the risk of break-up is eliminated by structural measures.

6.3.3. Prevention of collision with other spacecraft, etc.

Article 23 of the Regulation (Measures Relating to Control of Spacecraft)

(iii) in the case of a spacecraft capable of transferring from the orbit set forth in Article 20, paragraph (2), item (iii) of the Act to another orbit, measures to avoid other spacecraft, etc. if it is determined appropriate to do so when detecting the possibility of a collision with that other spacecraft, etc.

Review Standards

3. Prevention of collision with another spacecraft, etc.

- The applicant provides the methods of obtaining information on the possibility of collision with another spacecraft, etc. and the measures to be taken in case of obtaining the relevant information.

- In the case of a spacecraft capable of transferring to another obit, provide for the method for obtaining information on the possibility of collision with other spacecraft, etc. (including spacecraft after the completion of the control and orbital stages) and the conditions for determining whether to take avoidance measures in case where the relevant information is obtained.
- For example, develop an organizational structure whereby the applicant obtains from JSpOC information on an approach by other spacecraft, etc. to the spacecraft subject to the control by the applicant, and provide for a control plan including the analysis of possibility of collision and the execution of avoidance measures if it is determined, upon obtaining the information on approaches, that the possibility is high but may be effectively reduced based on the assessment of change in the probability of collision due to the avoidance measures.

Orbit information on manned spacecraft, etc. are available from the following website, subject to a user registration.

- JSpOC information
  <https://www.space-track.org/auth/login>

6.3.4. Establishment of organizational structure for the implementation of the control of spacecraft

Review Standards
4. Establishment of organizational structures for the implementation of the control of spacecraft
- In order to ensure the control plan set forth in 1 through 3 above, the following appropriate organizational structures are established.
- Organization for management and its duties
- Response to anomalies
- Establishment of security measures

In order to ensure the appropriate implementation of the control plan, the applicant must develop the following organizational structures:

– Organization for control and duties
  Clearly explain the persons in charge of respective duties as well as their roles and responsibilities, using a management structure chart, etc.

For example, describe the following information:

- Outline of the roles of officers and employees, organizations of sections in charge of general management as well as sections in charge of receiving information from JSpOC and response (a tree diagram, etc.), and the outline of duties of each person in charge.
- Capabilities of persons in charge of the operation (personnel capable of implementing the operation, etc.) and a training plan for them.
- In case of shiftwork, the method of shiftwork, method of transferring duties between the shifts.

– Response to anomalies

Provide for an organizational structure and method of monitoring for detecting anomalies. In addition, establish a process of response to the detected anomaly, including the determination of whether to continue or suspend the operation.

For example, describe the following information:

- Organization and line of communication in case of detecting an anomaly (a tree diagram, etc.)
- Details of categories of detected anomalies to which each person in charge at the time of the operation is to respond
- Determination of whether to continue or suspend the operation in case of detecting any anomaly (a flow chart, etc.)
- A plan approved through prior training, etc. so as to enable each person in charge to respond to the anomalies in the course of operation, and the training plan therefor
- Allocation of responsibilities and roles and the organization for identifying the cause with a view to establishing the permanent measures to be taken after the initial response

In cases where a part of these response measures are to be implemented by an automated system, show that the system operates in an appropriate way.

– Establishment of security measures

In relation to the spacecraft control facility, take measures to prevent important information related to the control plan from being leaked outside or misappropriated, and measures to prevent an easy entry from outside.

For example, describe the following information:

- Organizational structure of persons in charge, including persons responsible for information security and its implementation (e.g. a tree diagram)
- For communication, that the system enables the detection and discovery of problems upon the connection with outside through periodic checks, including security measures such as encryption and antivirus protection
- Provisions of information security regulations for the operation and the method for complying with these regulations
- The method of management of entry into and exit from the spacecraft control facility and the method of management of recording media

6.4. Termination measures

6.4.1 Controlled reentry into Earth

Article 22 of the Act (Requirements for License)

(iv) the details of the termination measures satisfy any of the conditions specified in the following items (a) through (d):

(a) to control the position, attitude and condition of the spacecraft to descend its altitude and burn in the atmosphere (including the retrieval of a part of the components by guiding them to fall on the ground surface or water surface without burning), while ensuring the safety of the vicinity of the trajectory of the spacecraft and an expected point of landing or water landing of the part of the components;

Review Standards

(In the case of Article 22, item (iv)(a) of the Act)

The applicant provides measures for the controlled reentry (e.g. trajectory, landing point) while ensuring the safety of an expected point of landing or water landing.

- In case of a spacecraft for which the control is to be terminated by way of controlled reentry, take the following steps:
  (1) Designation of an expected reentry area (an area covering the range of falling of spacecraft and fragments)
  (2) Determination of conditions for enabling the implementation of reentry (including the avoidance of collision with other spacecraft, etc. including manned spacecraft, etc.)
  (3) Calculation of expected casualties (6.2.4)
  (4) Establishment of a line of communication with relevant agencies (e.g. states

interfering with the expected reentry area, competent authorities for the air route and sea route)

6.4.2. Transfer to a region away from a geostationary orbit protected region

Article 22 of the Act (Requirements for License) (iv)the details of the termination measures satisfy any of the conditions specified in the following items (a) through (d): (b) to control the position, attitude and condition of the spacecraft to increase its altitude and put it into an Earth orbit from which its altitude will not decrease as time passes, without any risk of causing any adverse effect on the control of other spacecraft; Review Standards (In the case of Article 22, item (iv)(b) of the Act) The applicant provides measures to elevate the spacecraft to the altitude that would not have any adverse effect on the control of other spacecraft.

- As for spacecraft for which the control is to be terminated by increasing the altitude of orbit (in general, geostationary orbit spacecraft and highly elliptical orbit of which altitude of perigee would interfere with the protected region for geostationary orbit), the spacecraft must be transferred to the orbit that satisfies one of the following conditions in order to avoid collision with other nearby spacecraft.

  a) The initial eccentricity after the termination measure is 0.003 or less, and the minimum perigee altitude above geostationary altitude, ΔH (km) is given as follows.

$$\Delta H = 235 + 1{,}000 \cdot \mathrm{CR} \cdot \frac{A}{m} (km)$$

  CR: Coefficient of solar radiation pressure
  A: Effective cross-section of a spacecraft (m^2)
  m: Mass of spacecraft (kg)

  b) If the initial eccentricity after termination exceeds 0.003, it must not interfere with the protected region for geostationary orbit for 100 years

considering long term perturbation.

- If there is a possibility of break-up of the spacecraft due to the residual liquid propellant, residual high-pressure fluid or anomaly in a battery, take the same measures as those provided in 6.3.2 so as to prevent any unexpected activation or explosion.

6.4.3. Insertion on orbit of a celestial body other than the Earth

Article 22 of the Act (Requirements for License)

(iv) the details of the termination measures satisfy any of the conditions specified in the following items (a) through (d):

(c) to control the position, attitude and condition of the spacecraft to put it into the orbit around a celestial body other than the Earth or guide it to fall to the celestial body, without any risk of significantly deteriorating the environment of the celestial body;

Review Standards

(In the case of Article 22, item (iv)(c) of the Act)

The applicant provides measures to put the spacecraft into the orbit around a celestial body other than the Earth or guide it to fall to the celestial body, without any risk of significantly deteriorating the environment of the celestial body.

- In the case of a spacecraft which is put into the orbit around a celestial body other than the Earth or which is to be guided to fall to the celestial body, take termination measures in compliance with the Planetary Protection Policy stipulated by the Committee on Space Research (COSPAR).

6.4.4. Other termination measures

Article 22 of the Act (Requirements for License)

(iv) the details of the termination measures satisfy any of the conditions specified in the following items (a) through (d):

(d) if it is impossible to implement the measures set forth in items (a) through (c), to suspend the control of the spacecraft after taking measures to prevent the unexpected activation and explosion or other measures that are necessary for the prevention of harmful contamination of outer space, etc. as specified by Cabinet Office Order, and notifying the Prime Minister of the position,

attitude and condition of the spacecraft.

Article 24 of the Regulation (Termination Measures)

(i) measures to prevent an unexpected activation and explosion after the termination of control of spacecraft; and

(ii) in the case of a spacecraft capable of transferring from the orbit set forth in Article 20, paragraph (2), item (iii) of the Act to another orbit, measures to transfer to an orbit which would not have an adverse effect on the control of other spacecraft as practicable as possible.

Review Standards

(In the case of Article 22, item (iv)(d) of the Act)

- The applicant provides measures to vent residual energy, including residual propellant and electricity, which may cause break-up of the spacecraft or to prevent the break-up.
- Upon the termination of the control of the spacecraft, the following measures are to be taken for the protected regions:
  - Efforts must be made so that the spacecraft will be removed from the low earth orbit region within 25 years from the termination of the control.
  - The spacecraft is to be removed from the geosynchronous orbit immediately.

・ If there is a possibility of break-up of the spacecraft due to the residual liquid propellant, residual high-pressure fluid or anomaly in a battery, take the same measures as those provided in 6.3.2 so as to prevent any unexpected activation or explosion. However, this does not apply to the case where there is no possibility of break-up.

・ As for the spacecraft that are capable of transferring to another orbit, the following measures according to each orbit must be taken in addition to the above measures.

➢ Measures for low earth orbit protection region

As for spacecraft of which orbit interferes with the low earth orbit protected region, take one of the following measures so that the existence period of the spacecraft in the protection region after execution of the measure will be as short as possible. For a reentry to earth, follow 6.2.4.

(1) Orbital lifetime reduction

If the orbital lifetime of the spacecraft after completion of termination measure exceeds 25 years, the spacecraft is to be transferred to an orbit that leads a spacecraft to natural decay within 25 years.

(2) Natural decay

If a spacecraft will fall naturally due to atmospheric drag within 25 years, it is not particularly necessary to transfer the spacecraft to another orbit. For example, in the case where a spacecraft which would fall naturally within 25 years if it is put into the scheduled orbit will not fall naturally within 25 years as a result of being put into the orbit of much higher altitude than expectation due to an anomaly in orbital insertion by a launch vehicle, if possible, it is desirable to transfer the spacecraft to an orbit that would lead to natural decay within 25 years.

(3) Transferring to the altitude that does not interfere with the low earth orbit protected region

In cases where the measures described in (1) or (2) are not appropriate from the standpoint of ensuring public safety or the altitude of the measures are not realistic in terms of altitude for operation, the spacecraft must be transferred to a higher orbit that does not interfere with the low earth orbit protected region so as to avoid collision with other spacecraft, etc. including manned spacecraft, etc.

(4) Retrieval on orbit

Remove the spacecraft from the protection region for low earth orbit by retrieving the spacecraft on orbit.

- Measures related to the geostationary earth orbit protected region

  For a spacecraft with an orbital interference with the geostationary earth orbit protected region, transfer it to a lower orbit to avoid the interference (this is generally applicable to a highly elliptical orbit satellite for which the altitude of apogee interferes with the geostationary earth orbit protected region).

7. Permission, etc. related to change

Article 20 of the Act (License)
(2) A person who intends to obtain the license under the preceding paragraph must submit a written application to the Prime Minister, pursuant to the provisions of

Cabinet Office Order, specifying the following information, attaching the documents specified by Cabinet Office Order:

(i) the person's name and address;

(ii) the location of the spacecraft control facility;

(iii) if the spacecraft is to be used by putting it into Earth orbit, the orbit of the spacecraft;

(iv) the purposes and methods of use of the spacecraft;

(v) the configuration of the spacecraft;

(vi) the details of the measures to be taken upon the termination of the control of the spacecraft (hereinafter referred to as "termination measures");

(vii) beyond what is set forth in the preceding items, a plan setting forth the methods of the control of the spacecraft (hereinafter referred to as a "control plan");

(viii) if the applicant is an individual, the name and address of the person who will implement the control of the spacecraft upon the death of the applicant on behalf of the applicant (hereinafter referred to as the "representative in case of death"); and

(ix) other matters specified by Cabinet Office Order.

Article 23 of the Act (Permission, etc. Related to Change)

(1) When a person who obtained the license under Article 20, paragraph (1) (hereinafter referred to as a "spacecraft control operator") intends to change any matter set forth in items (iv) through (viii) of paragraph (2) of that Article, the person must obtain a license from the Prime Minister pursuant to the provisions of Cabinet Office Order; provided, however, that this does not apply to minor changes specified by Cabinet Office Order.

If any information stated in the application documents is changed, it is necessary to submit the following application for permission or notification of change, depending on the items to be changed and the degree of change. Those who cannot determine which of the license or notification would be necessary are recommended to consult the NSPS in advance.

7.1. Application for permission to make changes

7.1.1. Scope of application for permission to make changes

An operator that intends to make any change relating to Article 20, paragraph (2),

items (iv) through (viii) is required to submit an application for permission to make changes, except for a change that would not result in any substantial change as indicated in 7.2.

7.1.2. Specific examples for application for permission to make changes

- Change of specifications of equipment
- Change of design
- Change of details of termination measures

7.2. Notification of change

Article 25 of the Regulation (Application, etc. for Permission Related to Change) (3) The minor changes specified by Cabinet Office Order, as referred to in the proviso to Article 23, paragraph (1) of the Act, are changes that would not result in a substantial change in the matters set forth in Article 20, paragraph (2), items (iv) through (viii) of the Act.

7.2.1. Scope of notification of change

It is necessary to submit a notification of change if any of the following applies:

- if the operator intends to make a change related to Article 20, paragraph (2), items (i) through (iii) or item (ix) of the Act.
- if the change would not result in any substantial change in relation to items (iv) through (viii) of that paragraph.

7.2.2. Specific examples for notification of change

- In relation to Article 20, paragraph (2), item (i) of the Act, if the spacecraft control operator is an individual, a change of name due to such reasons as marriage and change of address due to relocation, or if the spacecraft control operator is a corporation, a change of the corporate name or change of address due to relocation of its office.
- In relation to items (iv) through (viii) of that paragraph, a change of a function not affecting the prevention of harmful contamination, etc. of outer space and securing public safety (parts related to a mission not related to 6.1 through 6.4).
- In relation to item (vii) of that paragraph, a change in organization within the scope not affecting the execution of the control plan.
- In relation to item (ix) of that paragraph, a change of name of officers or employees due to such reasons as marriage.

- Correction of an error in the application documents.

8. Review of Guidelines

The contents of these Guidelines relating to control of spacecraft are subject to change depending on the progress of technology, international development, etc. These Guidelines are to be reviewed as necessary, considering the future change in circumstances.