Guidelines on Permission Related to Launching of Spacecraft, etc.

Revised first edition dated March 30, 2018

Cabinet Office
National Space Policy Secretariat

History of revisions

Edition	Date of establishment	Detail of revisions
First Edition	November 15, 2017	New establishment
Revised first edition	March 30, 2018	Full revision

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1. Introduction

These Guidelines are intended to provide guidance to the concept of compliance and specific examples related to the review standards on permission related to the launching of spacecraft, etc. as provided in the Review Standards and Standard Period of Time for Process 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 Period of Time for Process Relating to Procedures under the Act on Launching of Spacecraft, etc. and Control of Spacecraft

3. Definitions of terms

Unless otherwise indicated, 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 Period of Time for Process 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

- Launching 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.

- Flight termination measures
  Destruction of a launch vehicle or any other measures to terminate the flight in cases of the deviation of the launch vehicle from its planned trajectory or any other anomalies.

- Flight safety operation
  Measures to be taken until the completion of launch of a spacecraft, etc. so as to minimize the possibility of damage caused to human life or body, or property on the ground, water surface, an aircraft in flight or other flying objects caused by the fall, collision or explosion of a spacecraft, etc. in whole or part, that has not been successfully separated from the launch vehicle and to ensure public safety.

- Radio equipment
  Electrical equipment for transmitting or receiving codes using electromagnetic waves, and a computer connected to the equipment via telecommunication lines.

- Impact limit line
  A line defined for ensuring the safety that indicates the boundary limit beyond which a launch vehicle must not cause any harmful effect in cases of termination of flight of the launch vehicle.

- Planned impact area
  A planned impact area of objects to be separated and jettisoned from a launch vehicle in the course of its normal flight, including combustion residue and fairings of a launch vehicle.

- Estimated impact area
  A range affected by hazards caused by a launch vehicle in flight including a flight in anomalies, such as the fall of the body of the launch vehicle and its fragments.

- Launch plan
  A plan setting forth the methods for launching the spacecraft, etc., including a schedule for launching the spacecraft, etc., a trajectory of the launch vehicle, and the method of ensuring the safety of the vicinity of the trajectory and launch site

- Orbital stage

A body of a launch vehicle to be put into Earth orbit or beyond.

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

- 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 a 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 launching of a spacecraft, etc. using a launch site located in Japan or onboard a ship or aircraft with Japanese nationality needs to obtain permission from the Prime Minister for each instance of launching.
The application is not required for a launching of a spacecraft, etc. completed before the full enforcement of the Act or a launching of a sub-orbital rocket not loaded with any spacecraft.

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

5.1. Application process

For obtaining permission related to the launching of spacecraft, etc., the applicant needs to comply with the criteria for permission in light of the following four aspects.
(i) design of the launch vehicle
(ii) launch site

(iii) launch plan and ability to implement the launch plan
(iv) purpose and method of spacecraft to be loaded on a launch vehicle

For (i) and (ii) above, the type certification system and compliance certification system are available. These items may be replaced with certification numbers if the applicant intends to use a launch vehicle or launch site for which these certifications are obtained.
For (iii) and (iv), an application is required for each instance of launch.

An applicant is recommended to hold a prior consultation with the National Space Policy Secretariat of the Cabinet Office of Japan (hereinafter referred to as the "NSPS") from the preparation phase 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

- In cases where a type certification is obtained: 1-3 months
- Other cases: 4-6 months

The standard period of time for process is the length of time generally required for processing an application without any omission or other 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 date of launch.
In cases of a launch using a launch vehicle, launch site and launch plan that proved to be successful in the past, it is highly possible that the time required for the review will be accelerated. If the applicant intends to launch a spacecraft with the same specification as the past according to the substantially identical launch plan, it is highly probable that the review will be accelerated by showing the point of difference marked against the past experience. In order to prepare application documents in an effective way, the applicant is recommended to consult with the NSPS in advance.

6. Permission related to launching of spacecraft, etc.

Article 6 of the Act (Requirements for Permission)
The Prime Minister must not grant the permission under Article 4, paragraph (1),

unless the Prime Minister determines that the application for the permission under that paragraph meets all of the following requirements:

(i) the design of the launch vehicle complies with the standard specified by Cabinet Office Order as the safety standard concerning a launch vehicle for ensuring the safety of the vicinity of the trajectory and launch site of the launch vehicle (hereinafter referred to as a "launch vehicle safety standard"), or the design has obtained a type certification under Article 13, paragraph (1) or a foreign certification;

(ii) the launch site is equipped with radio equipment set forth in the following items (a) and (b) or otherwise complies with the standard specified by Cabinet Office Order according to the type of launch vehicle as the safety standard concerning a launch site for ensuring the safety of the vicinity of the trajectory and launch site of the launch vehicle (hereinafter referred to as a "type-specific site safety standard"), or the launch site has obtained a compliance certification under Article 16, paragraph (1):

(a) radio equipment equipped with a function to detect signals indicating the position, attitude and condition of a launch vehicle transmitted by radio equipment onboard the launch vehicle either directly or by receiving it via other radio equipment using electromagnetic waves, or to detect the position of the launch vehicle by transmitting signals to the launch vehicle either directly or via other radio equipment and then receiving the reflected signals either directly or via other radio equipment;

(b) radio equipment equipped with a function of transmitting signals necessary for the destruction of a launch vehicle or any other measures to terminate the flight in the case of the deviation of the launch vehicle from the scheduled trajectory or any other extraordinary circumstances (referred to as "flight termination measures" in the following item and Article 16, paragraph (2), item (iv)) to the radio equipment onboard the launch vehicle either directly or via other radio equipment using electromagnetic waves;

(iii) the launch plan sets forth the flight termination measures or other means of ensuring the safety of the vicinity of the trajectory and launch site of the launch vehicle, that the details of the plan are appropriate in light of ensuring public safety, and that the applicant has a sufficient ability to execute the launch plan; and

(iv) the purposes and methods of use of the spacecraft loaded on the launch vehicle

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 ensuring public safety.

6.1. Design of the launch vehicle

Refer to the Guidelines on Type Certification for Launch Vehicles.

6.2. Launch site

Refer to the Guidelines on Compliance Certification for Launch Sites.

6.3. Launch plan

6.3.1. Safety and security measures

Review Standards 1. Safety and security measures - In connection with the launching of a spacecraft, etc. (hereinafter simply referred to as a "launch"), the applicant takes appropriate safety and security measures during the period from the prelaunch processing phase to the completion of launch.

6.3.1.1 Safety

In order to prevent disasters, distinguish materials that may cause third-party damages unless the appropriate safety measures are taken, for example, materials having high energy as their physical property or materials that are hazardous to human body, and take safety measures accordingly.

Examples of hazardous materials to be used and safety measures for these materials are as follows:
The following examples of safety measures are for ensuring the safety of third parties according to the purpose of the Act. For ensuring the safety of staff members engaged in launch operation, the applicant is required to comply with the laws and regulations related to industrial safety, etc.

(1) Examples of hazardous materials to be used
  (i) Materials regulated under the Explosives Control Act
    - Solid propellant
    - Pyrotechnic devices (including a solid rocket motor)

(ii) Materials regulated under the High Pressure Gas Safety Act

- Liquid propellants categorized as liquefied gas
- Inert gas loaded on a launch vehicle and spacecraft
- Inert gas used for purging vehicles and pipes during preparation period

(iii) Materials regulated under the Fire Service Act and Poisonous and Deleterious Substances Control Act

- Inflammable or autoreactive petroleum and liquid propellants
- Liquid propellants that are hazardous to human body

(2) Safety measures

Follow the necessary procedures complying with the applicable laws and regulations, and develop the appropriate safety measures.

For all stages, including the receipt, storage, loading on a launch vehicle or spacecraft, use for operation, and disposal thereof, take both the operational and technical safety measures.

(i) Development of organizational structures

- Appoint a person responsible for handling hazardous materials who assumes responsibility for the safe performance of operation, and develop organizational structures to enable the responsible person to promptly receive a report and grasp situations in case of any problems and to make a necessary communication within or outside the launch site.
- For the handling of hazardous materials, including the appointment of a responsible person required under the laws, comply with the laws and regulations relevant to the hazardous materials to be used.

(ii) Development of accident response plan

- Consider the risk of occurrence of accidents related to hazardous materials and develop countermeasures to prevent damages to third parties in advance.
- Consider and discuss countermeasures paying due regards to ancillary damages. Make clear the outside organization to report to in cases of occurrence of accidents and procedures for reporting.
- Make prior arrangements for notification to residents in the vicinity of the launch site at the time of occurrence of accidents and the evacuation means.

If persons related to launch take charge of the evacuation and ensuring of safety of third parties, provide the persons with necessary education and training.

(iii) Safety measures relating to facility and equipment

- For facilities and equipment for storing and handling of hazardous materials, comply with the applicable laws and regulations as well as safety requirements of the launch site to be used.
- In cases of establishing two or more sites for storing explosive hazardous materials, measures must be taken to prevent an explosion induced by a single accident, including blast-proof buildings and determination of appropriate distances. These measures must be finally included in the determination of restricted areas (6.3.6).
- Install a lightning rod to prevent lightning damages.
- Implement mechanisms for detecting anomalies by installing detectors and alarming devices.

6.3.1.2. Security

The following measures must be taken.

(1) Development of organizational structures

- Appoint a person responsible for security and clearly provide for the person's responsibilities and authorities, and develop organizational structures to enable the responsible person to promptly receive a report and grasp situations in case of occurrence of any security incidents and to make a necessary communication within or outside the launch site.
- Identify important information related to important facilities, devices and launch, and appoint a minimum number of persons who are permitted to access such information. Take measures to distinguish persons authorized to access information by such way as wearing a badge.

(2) Measures to prevent entry of third parties

- For the following facilities, etc., implement measures to prevent access of persons other than those specified in (1) above, for each phase from the preparation period to the completion of launch of launch vehicle as necessary, according to the types of hazardous materials and characteristics of launch vehicle (e.g. type of propellants and vehicle control systems). These measures

include an entry and exit control system, surveillance by security guards and monitoring camera.

(i) Places of storage of hazardous materials including explosives
(ii) Building for assembling launch vehicles and spacecraft
(iii) Vicinity of launch pad
(iv) Building for flight safety operation

- If, for a certain period of time, the applicant did not implement any security measures, check in advance of starting the operation that no unknown object has been placed during that period.

(3) Establishment of information security systems

- For important information concerning launch, implement measures to prevent access by persons other than those specified in (1) above, by such way as creating a firewall.
- If, for a certain period of time other than the launch preparation period, the applicant did not take any information security measures, check in advance of starting the operation that no data has been tampered with during that period.

6.3.2. Development of disaster prevention plans

Review Standards

2. Development of disaster prevention plan, etc.

- The applicant prepares a disaster prevention plan for preventing the occurrence of a disaster at the launch site, and complies with the related laws and regulations for ensuring the safety of facilities and handling thereof necessary for the disaster prevention.
- The applicant ensures that information including the detection of fire and gas, security alarm, etc. is centralized and is kept updated on the status, and performs a sufficient facility inspection for fire prevention, firefighting and protection facilities before doing any hazardous activities.

The applicant must prepare a disaster prevention plan considering the following disaster prevention facilities and hazardous materials processing facilities.

(i) Alarming devices
(ii) Fire prevention and firefighting facilities
(iii) Waste liquid processing facilities for hydrazine, etc.

(iv) Any other facilities necessary for disaster prevention

The applicant must centralize information including the detection of fire and gas and security alarm and always monitor the relevant information, and perform a sufficient inspection of facilities for fire prevention, firefighting and protection before doing any hazardous activities.
The applicant must ensure safety of handling of propellants, etc. (meaning explosives, high-pressure gases and hazardous materials, etc.) in accordance with 6.3.3.

6.3.3. Safety measures related to handling of propellant

Review Standards
3. Safety measures related to handling of propellant, etc. - The applicant establishes measures based on the applicable laws and regulations, so as to ensure the safety of handling of propellant, etc. (meaning explosives, high-pressure gases and hazardous materials, etc.) at the launch site.

In order to ensure the safety of handling of propellant, etc. (e.g. explosives, high-pressure gases and hazardous materials) at the launch site, the applicant must implement the measures set forth in 6.3.1.1 and take the following measures in relation to propellant, etc. according to the types of propellants.

- Suspend the operation if the ambient temperature or the humidity of the propellant deviates from the range of use of the propellant.
- Prevent the generation of static electricity when handling propellants.
- Detect the leakage of toxic or other hazardous propellants and prevent the dispersion of the leaked propellant.
- Check testing equipment for pyrotechnic devices for their soundness.
- As a general rule, prohibit the use of any equipment requiring radio emission or high current when connecting wiring of pyrotechnic devices or arming a vehicle. If it is unavoidable to use them, confirm in advance that there will be no unexpected activation. Refrain from carrying unnecessary electronic devices or turn them off.

6.3.4. Determination of trajectory considering the planned impact area, etc.

6.3.4.1 Planned impact area for jettisoned objects

Review Standards
4. Design of trajectory considering the planned impact area, etc.

- The planned impact area of objects to be separated and jettisoned from a spacecraft launch vehicle (hereinafter simply referred to as a "launch vehicle") in the course of its normal flight, including its combustion residue, is separated from the land or its surrounding sea waters to the possible extent.
- The planned impact area would not interfere with any territory or territorial waters of a foreign state. If any interference is expected, the applicant obtains consent from the relevant state.

For an object to be jettisoned from a launch vehicle according to a plan, designate a planned impact area for jettisoned objects considering the following factors:

- Uncertainty of trajectory (position and velocity)
- Difference in separation timing of jettisons caused by mechanical errors or electrical delay
- Uncertainty of aerodynamic characteristics of jettisons
- Wind around the planned impact area for the jettisons

For designating a planned impact area for jettisoned objects, land and its surrounding seawater is not to be designated as a planned impact area for the jettisoned object as practicable as possible. In addition, designate the area to avoid interference with territorial land and waters of foreign states, and, to the maximum extent necessary, to avoid interference with an Exclusive Economic Zone of foreign states.

If, due to any unavoidable reason, a planned impact area for jettisoned objects is to be designed on the territory of a foreign state including the territorial land or waters, comply with the relevant state's regulations, safety standards and instructions from the competent authorities and obtain consent from that state. If the planned impact area for jettisoned objects is to be designed in the territory of Japan including its territorial land or waters, avoid the land where people reside.

For navigation of aircraft, ships, etc., ensure the safety by implementing the procedures set forth in 6.3.8 as well.

6.3.4.2. Trajectory

Review Standards

- For a dispersion area of a trajectory of the estimated impact point in the case of a sudden thrust termination of a launch vehicle in thrust flight (a trajectory of estimated impact point), a trajectory has been determined so that the launch vehicle

will pass an area as far as possible from densely populated areas, and the necessary measures have been taken so that the level of risk to the vicinity of the trajectory and launch site will not exceed the international standard or standard provided by the space agency of each state, even in emergency situations.

The trajectory of the vehicle must be determined so that the dispersion of the trajectory of the estimated impact point (generally in 3σ) will pass as far away as possible from densely populated areas. In addition, calculate the expected casualties and demonstrate that the value thereof does not exceed the criteria of international standard specified in the "Conditions for Calculating Number of Expected Casualties and Its Methods (Launch Vehicles)" attached to these Guidelines.
In cases of ensuring safety by other methods, analyze the effect concerning the ensuring of public safety and take necessary measures.

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

$$E_{C-Total} = \sum_i \sum_j E_{Cij}$$

$$E_{C_{ij}} = P_{I_{ij}} \left(\frac{N_{F_i}}{A_{P_j}} \right) \left(N_{P_j} A_{C_i} \right)$$

where

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 group i
N_{Pj}: the population of population center j
A_{Pj}: the area of the population center j

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

6.3.5. Establishment of the appropriate impact limit line

Review Standards

5. Design of the appropriate impact limit lines

- The applicant establishes a set of lines indicating the boundary limit beyond which the launch vehicle must not cause any harmful effect in case of suspension of flight of the launch vehicle to ensure safety (i.e. impact limit lines).

An impact limit line must be established to indicate the boundary of areas to be protected from damages that may be caused by fall, etc. of a launch vehicle. Activities relating to launch must be implemented within the area not giving any harm to the region protected by the impact limit line.

More concretely, consideration must be paid for the prevention of third-party damages in the vicinity of the launch site, and the impact limit line must be designed within the restricted area for launch (6.3.6.2) in cases of land. For other areas than the vicinity of the launch site, consideration must be paid for territorial waters, and the impact limit line must be set at a place away from the coast line by 30km or more; provided, however, that this does not apply to an island uninhabited at the time of launch.

6.3.6. Creation of restricted area and establishment of system to prevent entry of third parties

Review Standards

6. Creation of restricted area and establishment of system to prevent entry of third parties

- The applicant designates a restricted area according to each stage during the preparation period for launch considering the situations surrounding the launch site, and restricts entry of non-related parties.

(1) Restricted area for preparation period

For each stage of launch vehicle assembling work, the applicant designates a warning area to minimize the effect of an accident, etc.

(2) Restricted area for launch

Restricted areas for launch cover all of the areas which are, at least, included in the following restricted areas for ground safety and flight safety.

[Restricted area for ground safety]

At least blast, scattering objects, gas, radiation heat generated by a fireball, etc. are taken into consideration.

[Restricted area for flight safety]

The following matters are taken into consideration:

(A) The area is capable of preventing the occurrence of the following hazards in the vicinity of the launch site.

(i) Collision of falling objects

(ii) Blast in case of explosion in flight

(iii) Blast and secondary scattering of fragments caused by a secondary explosion when there is a risk of a solid propellant falling to and impacting the ground surface, etc. and exploding (secondary explosion)

(iv) Leak and dispersion of propellant onboard

(B) In addition, in relation to the sea waters in the vicinity of the launch site, the distribution of impact of fragments generated due to the termination of flight immediately after the lift-off is evaluated, and the hazard to ships, etc. that may be caused by the impact of fragments is prevented to the possible extent.

As indicated in 6.3.6.1 and 6.3.6.2, designate restricted areas for launch preparation period and launch. When designating restricted areas, pay attention to all propellants and pyrotechnic devices including a launch vehicle and spacecraft. In cases where any propellant, etc. not specified in this section is to be loaded, separately calculate the necessary distance using an appropriate conversion ratio. If the applicant intends to design the restricted areas using a method not described in this section, including the use of a different conversion ratio, the applicant is required to show evidence.

In cases where the applicant takes measures by other methods, including protection measures against leakage at the facility (e.g. a protection wall and barrier), a reduction of the restricted areas commensurate with the effect of these measures may be considered by showing the effectiveness of these measures.

For the designed restricted area, clarify the timing of commencement and termination of designation, make this information available to related parties and restrict third-party access to the restricted areas during the restricted period.

6.3.6.1. Restricted area for preparation period

(1) Ground restricted area and sea restricted area

In order to minimize the effect of accident, etc. including a secondary explosion, the restricted area for launch preparation period according to the respective hazardous materials must be at least within circles both with a radius equal to the larger of the two safety distances derived from (i) and (ii), and with the center being the locations of storage and operation.

(i) Explosives including gunpowder and propellant

(a) In the case of explosives containing pyrotechnic devices only

$$R = 2 \times 2.5 \times w_p^{\frac{1}{3}}$$

R: Safety distance (m)

w_p: Mass of propellant, etc. (kg)

* If propellant, etc. to be used for a pyrotechnic device is gunpowder, "w_p" in the above formula may be multiplied by 0.5.

(b) In the case of explosives containing liquid propellants (e.g. hydrazine, nitrogen tetroxide "hereinafter referred to as "NTO")) only

a. In the case of explosives containing NTO only

The safety distance specified in Table 1 is applied.

However, for NTO stored in a static way, the domestic laws including the Fire Service Act are applicable.

b. In the case of explosives containing hydrazine only

The safety distance specified in Table 1 is applied.

However, for hydrazine stored in a static way, the domestic laws including the Fire Service Act are applicable.

c. In the case of explosives containing both hydrazine and NTO

The larger safety distance of the two is applied, one specified in Table 1 for the case of hydrazine only and the other converted to that corresponding to the total mass of both the propellant specified in Table 1 for the case of coexistence of both hydrazine and NTO using the TNT conversion factor of Te=0.1.

(c) Both solid propellants and liquid propellants (hydrazine, NTO)

a. Operation or storage period other than cryogenic inspection and lift-off rehearsal

The safety distance for the total mass converted to that specified in Table 1 using conversion factors of Te=0.05 for solid propellant and Te=0.1 for liquid propellant (hydrazine or NTO).

b. At cryogenic inspection and lift-off rehearsal

The safety distance according to the ground restricted areas (A) through (C) in 6.3.6.2(1) is applicable.

(ii) Hazardous materials generating hazardous gases

The safety distance according to the ground restricted area (D) in 6.3.6.2(1) is applicable.

(2) Air restricted areas

N/A

Table 1 Safety distances for preparation period

Mass of propellant, etc.		NTO (Note 1)		Hydrazine (Note 2)		A case where both hydrazine and NTO exist; or where these and solid propellants exist (Note 3)	
kg	(lbs)	m	(ft)	m	(ft)	m	(ft)
0.1	(0.2)	15.2	(50)	243.8	(800)	71.9	(236)
0.2	(0.5)	15.2	(50)	243.8	(800)	72.1	(236)
0.3	(0.7)	15.2	(50)	243.8	(800)	80.2	(263)
0.5	(1)	15.2	(50)	243.8	(800)	88.8	(291)
4.5	(10)	15.2	(50)	243.8	(800)	144.4	(474)
9.1	(20)	15.2	(50)	243.8	(800)	161.1	(529)
13.6	(30)	15.2	(50)	243.8	(800)	170.9	(561)
22.7	(50)	15.2	(50)	243.8	(800)	183.2	(601)
45.4	(100)	15.2	(50)	243.8	(800)	200.4	(658)
65.4	(144)	15.2	(50)	243.8	(800)	243.8	(800)
90.7	(200)	15.2	(50)	243.8	(800)	282.6	(927)
136.1	(300)	15.2	(50)	243.8	(800)	330.6	(1085)
181.4	(400)	15.2	(50)	243.8	(800)	364.7	(1197)
204.1	(450)	15.2	(50)	243.8	(800)	378.7	(1243)
226.8	(500)	15.2	(50)	243.8	(800)	381.0	(1250)
453.6	(1,000)	15.2	(50)	243.8	(800)	381.0	(1250)
2,268	(5,000)	15.2	(50)	243.8	(800)	381.0	(1250)
4,536	(10,000)	15.2	(50)	243.8	(800)	381.0	(1250)
6,804	(15,000)	15.2	(50)	243.8	(800)	381.0	(1250)
9,072	(20,000)	15.2	(50)	243.8	(800)	381.0	(1250)
10,567	(23,297)	15.2	(50)	243.8	(800)	381.0	(1250)
11,340	(25,000)	15.2	(50)	249.6	(819)	381.0	(1250)
13,608	(30,000)	15.2	(50)	265.2	(870)	381.0	(1250)
16,785	(37,004)	15.2	(50)	284.5	(933)	406.3	(1333)
20,412	(45,000)	15.2	(50)	303.6	(996)	433.7	(1423)
22,680	(50,000)	15.2	(50)	314.5	(1,032)	449.2	(1474)
31,751	(70,000)	15.2	(50)	351.8	(1,154)	502.5	(1649)
45,359	(100,000)	15.2	(50)	396.2	(1,300)	566.0	(1857)
68,039	(150,000)	15.2	(50)	453.6	(1,488)	715.2	(2346)
90,718	(200,000)	15.2	(50)	499.2	(1,637)	844.4	(2770)
113,398	(250,000)	15.2	(50)	537.8	(1,764)	960.4	(3151)
120,201	(265,000)	15.2	(50)	548.3	(1,798)	979.1	(3212)
136,077	(300,000)	15.2	(50)	548.6	(1,800)	1020.5	(3347)
226,795	(500,000)	15.2	(50)	548.6	(1,800)	1209.9	(3969)

(Note) Source: AFMAN91-201(21 March 2017)

(Note 1) The safety distance for NTO/MON (nitrogen tetroxide with nitric monoxide)
15.2m (Constant)

(Note 2) The safety distance for hydrazine (tank burst pressure＞690kPa)
The minimum safety distance is 243.8m.
11.11 × Quantity of propellant ^(1/3) m
548.6m, in cases 120,201kg or more

(Note 3) A case where both hydrazine and NTO exist; or where these and solid propellants exist
The minimum safety distance is 71.9m.
TNT equivalent weight < 45.4 kg ⇒ 107.87 + [24.14 × ln(TNT equivalent weight)] m
45.4 kg ≤ TNT equivalent weight ≤ 204.1 kg ⇒ -251.87 + [118.56 × ln(TNT equivalent

weight)] m
204.1 kg < TNT equivalent weight ≤ 13,608 kg ⇒ 381.0 m
13,608 kg < TNT equivalent weight ≤ 45,359 kg ⇒ 15.87 × TNT equivalent weight^(1/3) m
45,359 kg < TNT equivalent weight ≤ 113,398 kg ⇒ 1.164 × TNT equivalent weight^0.577m
113,398 kg < TNT equivalent weight ⇒ 19.84 × TNT equivalent weight^(1/3) m
The minimum safety distance is 243.8m in cases where hydrazine exists.

Reference: Ministry of Education, Culture, Sports, Science and Technology, Committee on Development and Utilization of Outer Space "Standards for Assessment of Safety Measures for Launching of Spacecraft, etc. Using Launch Vehicles"

6.3.6.2. Restricted area for launching

(1) Ground restricted area

- A ground restricted area must be designated to include, at least, a circle with a radius equal to the largest among the safety distances calculated according to the following formulae (A) through (D) in relation to the dispersion of radiation heat and hazardous gas caused by blast, scattering objects, and fireball, and with the center being the launcher.
- Confirm in advance of launch that no third parties have entered the ground restricted area, and suspend the launch in cases of actual or potential entry of third parties.

(A) Safety distance for blast

The safety distance for blast is to be calculated by the following formulae 1 through 4. The mass of propellant to be used is converted to the equivalent mass of TNT according to the type of a launching vehicle to be used and total mass is to be derived as TNT equivalent mass.

$$R = \left(\frac{z_4}{\frac{1}{\Delta P^{1.41}}}\right) \times \left[\sum (T_e \times W_p)\right]^{\frac{1}{3}}$$ - Formula 1

R: Safety distance for blasting (m)
ΔP: Reference blast wave (kPa)
w_p: Mass of propellant, etc. (kg)
T_e: TNT conversion ratio

- TNT conversion ratio T_e
  Solid propellant: T_e =0.05
  Pyrotechnic devices: T_e =1
  Hydrazine/NTO: T_e = 0.1

LOX (liquid oxygen)/LH_2 (liquid hydrogen): $T_e = \frac{6.7}{[W_p]^{\frac{1}{3}}}$

Alcohol or kerosene/LOX: $T_e = 0.2$

(Calculate TNT conversion ratios for each of stages, auxiliary boosters and spacecraft, etc.)

- Reference blast wave

Apply the following according to Impulse I (Pa・s):

$$\left.\begin{array}{ll} \Delta P = 1.379 & (I \leqq 140) \\ \Delta P = 1.379 \times \left(\frac{140}{I}\right)^{0.24} & (140 < I < 400) \\ \Delta P = 1.073 & (I \geqq 140) \end{array}\right\} \text{- Formula 2}$$

Impulse I (Pa・s) is derived from the following two formulae:

$$I = [\Sigma(T_{et} \times W_p)]^{\frac{1}{3}} \times 367 \times Z^{\{-1.02+0.0072 \times \ln(Z)\}} \quad \text{- Formula 3}$$

$$Z = \frac{R}{[\Sigma(T_{ei} \times W_p)]^{\frac{1}{3}}} \quad \text{- Formula 4}$$

T_{ei}: TNT conversion ratio for the impulse calculation

Solid propellant: $T_{ei} = 0.05$ * Same as that for the calculation of safety distance for blasting

Pyrotechnic devices: $T_{ei} = 1$ * Same as that for the calculation of safety distance for blasting

Hydrazine/NTO: $T_{ei} = 0.1$ * Same as that for the calculation of safety distance for blasting

LOX/LH_2: $T_{et} = \frac{7.8}{W_p^{\frac{1}{3}}}$

Alcohol or kerosene/LOX:

$T_{ei} = 0.2$ * Same as that for the calculation of safety distance for blasting

(Calculate TNT conversion ratios for each of stages, auxiliary boosters and spacecraft, etc.)

* Parameter R and w_p are the same as those for the calculation of safety distance for blasting.

(B) Safety distance for scattering objects

The safety distance D for scattering objects must be calculated in accordance with the following formula:

The parameters are common.

D: Safety distance for scattering objects (m)

W_P: Mass of propellant, etc. (kg) *Total mass of all types and stages

(i) In cases where solid propellant and pyrotechnic devices are used; or where solid propellant, pyrotechnic devices and liquid propellant are used

$$D = 117 \times W_p^{0.21}$$

(ii) Liquid propellant (LOX/LH_2, hydrazine/NTO, alcohol/LOX or kerosene/LOX)

$$D = 59 \times W_p^{0.21}$$

(C) Safety distance for radiation heat by a fireball

The safety distance F(m) for a fireball must be calculated in accordance with the following formula:

(i) Solid propellant and pyrotechnic devices

The safety distance is the larger of the two "F" values calculated by separately applying the following conditions:

- F derived from the following formulae 5 through 7
- F derived from formula 5 where I_S = 12,560

$$I_S = 2.69 \times 10^7 \times \frac{[\Sigma(T_e \times w_p)]^{0.68}}{R^2}$$ - Formula 5

$$t_S = 0.258 \times [\Sigma(T_e \times w_p)]^{0.348}$$ - Formula 6

$$t_S \times I_S^{1.15} = 550{,}000$$ - Formula 7

I_S: Fireball radiation intensity (solid) (W/m^2)
t_S: Fireball duration (s)
w_p: Mass of propellant, etc. (kg)
T_e: TNT conversion ratio
Solid propellant: T_e: = 0.05
Pyrotechnic devices: T_e: = 1

*Formula 7 is the Eisenberg's criteria of irradiance against human.

(ii) Liquid propellant (LOX/LH_2, hydrazine/NTO, alcohol/LOX, or kerosene/LOX)
The safety distance is the larger of the two "F" values calculated by separately applying the following conditions:

- F derived from the following formulae 8 through 10
- F derived from formula 8 where I_L = 12,560

$$I_L = 8.58 \times 10^6 \times \frac{W_p^{\frac{2}{3}}}{F^2}$$ - Formula 8

* If other propellants, including solid propellants, are not used and only LOX/LH_2 must be used, the value may be multiplied by 0.85.

$$t_L = 1.82 \times W_p^{\frac{1}{6}}$$ - Formula 9

$$t_L \times I_L^{1.15} = 550{,}000$$ - Formula 10

I_L: Fireball radiation intensity (liquid) (W/m^2)
t_L: Fireball duration (s)
W_p: Mass of propellant (kg) *Total mass of all types and stages

(iii) In cases where solid propellants, etc. and liquid propellant are used
(a) $t_L \geqq t_S$
The safety distance is the larger of the two "F" values calculated by separately applying the following conditions to Formulae 5, 6, 8 and 9:

- $t_S \times (I_L + I_S)^{1.15} + (t_L - t_S) \times I_L^{1.15} = 550{,}000$
- $I_L + I_S = 12{,}560$

(b) $t_L < t_S$

The safety distance is the larger of the two "F" values calculated by separately applying the following conditions to Formulae 5, 6, 8 and 9:

- $t_L \times (I_S + I_L)^{1.15} + (t_S - t_L) \times I_S^{1.15} = 550{,}000$
- $I_S + I_L = 12{,}560$

(D) Safety distance for dispersion of hazardous gas

Calculate the appropriate safety distance based on such factors as the types of dispersed hazardous gas and wind velocity. In this case, the reduction of volume of dispersed gas caused by combustion and heat decomposition may be considered by showing evidence.

The allowable concentration of hazardous substance must be equal to the international standard or standards provided by a space agency of each country for each substance.

Reference: FAA 14CFR Part417 Launch Safety Appendix I, 23 March 2018
<https://www.ecfr.gov/cgi-bin/textidx?SID=02a9d3d9fa44edbab14f32a737f67121&mc=true&node=pt14.4.417&rgn=div5#ap14.4.417_1417.i>

For the purpose of a simulation test of allowable concentration of hazardous substances and other factors, Degadis and ALOHA tools provided by the United States Environmental Protection Agency (EPA) may be useful.
Degadis:
<https://cfpub.epa.gov/si/si_public_record_Report.cfm?dirEntryID=2904>
ALOHA:
<https://www.epa.gov/cameo/aloha-software>

(2) Sea restricted area

- A sea restricted area must be designated so that it includes, at least, sea waters for which the probability of falling of fragments on a ship is not less than 1×10^{-5}. However, a planned impact area for separated objects may be excluded from the sea restricted area subject to taking the procedures provided in 6.3.8.

- Confirm in advance of launch that no third parties have entered the sea restricted area, and suspend the launch in case of actual or potential entry of third parties.

(3) Air restricted area

- An air restricted area must be designated so that it covers, at least, the air above the following areas:
  - Ground restricted area
  - Sea restricted area
- Confirm in advance of launch that no third parties have entered the air restricted area, and suspend the launch in case of actual or potential entry of third parties.

6.3.7. Measures to be taken at the time of natural disaster warning

Review Standards
7. Measures to be taken at the time of natural disaster warning, etc. - The applicant provides measures in response to a warning of stormy weather, lightning strike, earthquake, etc.

Stipulate the measures against natural disasters including stormy weather, lightning strike and earthquake, as well as the conditions for the implementation of these measures, in accordance with the following:

- In the vicinity of the launch site, if stormy weather, lightning strike, earthquake, tsunami, etc. is predicted based on a warning by the Japan Meteorological Agency, independently observed data, etc., implement the measures to ensure safety of launch vehicles and facilities, and suspend the operation if necessary.
- If there is a possibility of any difference in electrical potentials between the launch site and airborne devices, implement appropriate measures such as earth connection and lightning protection design.

6.3.8. Prior notice to aircraft and ships

Review Standards
8. Prior notice to aircraft, ships, etc. - The applicant establishes communication means, etc. with relevant agencies so as to ensure the safety of aircraft, ships, etc. during the launch operation period.

Stipulate the guidelines on communicating information related the following areas and warning periods to stakeholders so as to ensure the safety of aircraft, ships and residents (e.g. method, timing, etc.)
In relation to the period requiring warning, fully take into consideration the period between the pre-launch and the time when the potential hazard is eliminated (e.g. pre-launch monitoring of restricted areas, scheduled launch period, length of time of falling separated objects, and length of time of floating on the sea after the separated objects fall on the sea).

(1) Aircraft

Take procedures for notifications including NOTAM (Notice to Airmen). For specific procedures, follow instructions from the authorities having jurisdiction over the air route.

These notifications relate to the following:

- Planned impact area for separated objects (6.3.4.1)
- Air restricted area

(2) Waterborne vessel

Take procedures for notification related to notice to mariners. For specific procedures, follow instructions from the authorities having jurisdiction over the water route.

These notifications relate to the following:

- Planned impact area for separated objects (6.3.4.1) as well as the types and size of the separated objects
- Sea restricted area

(3) Stakeholders in the vicinity of launch site

In relation to procedures for notification to the public in the vicinity of the launch site and safety measures for fishermen and other related parties of the surrounding sea waters, follow instructions from local governments having jurisdiction over the launch site.

These notifications relate to the following:

- Ground restricted area
- Sea restricted area
- Air restricted area

6.3.9. Determination of the appropriate date and time for launching

Review Standards 9. Determination of the appropriate date and time for launch - The applicant sets the date of launch such that a collision with international space stations or manned spacecraft on the orbit will be avoided, so as to ensure the safety of lives of persons operating on the orbit.

Take the following measures in relation to manned spacecraft, etc. so as to ensure the safety of lives of persons engaged in activities on the orbit.

Set the launch date and time so as to avoid any interference with manned spacecraft, etc. before the achievement of the following (1) or (2).

(1) Insertion into an orbit not interfering with the manned spacecraft, etc.

(2) In relation to the orbit interfering with manned spacecraft, etc., either of the following, whichever is the later:

- Completion of change sequence of attitude or orbit (maneuver, powered flight, etc.) (In cases where such sequences are executed after confirming the possibility of interference with manned spacecraft, etc., this can be excluded in relation to the determination of the launch date and time by explaining the plan)
- 60 hours from lift off of the launch vehicle

The following criteria (1) or (2) to regard that there is no interference with manned spacecraft is applied.

(1) It does not come close to an ellipsoidal miss distance 200 km in-track and 50 km cross-track or radially

(2) the probability of collision is less than $1x10^{-6}$.

Confirm the possibility of interference with manned spacecraft, etc. for a launching vehicle and all the separated objects of which altitude reach to over 150km. Here, however, if the spacecraft executes a maneuver during the period for confirmation described above after separation, it is not required to confirm the interference between manned spacecraft, etc. and spacecraft after the maneuver. For confirmation of interference, the uncertainties of trajectory in orbit insertion within the normal range must be taken into account.

Because orbital maneuver is executed by manned spacecraft as well, it is necessary

to confirm the probability of interference before the launch as latest as possible. Hence the collision avoidance plan must be prepared for application and collision avoidance procedure must be conducted upon the final decision for launch. The collision avoidance plan must show that if it is expected that interference may occur as a result of confirmation, the launch will be suspended or postponed.

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>

As a manned spacecraft changes its orbit on regular or non-regular basis, make the best efforts to obtain the related information and to use the latest information to the extent possible. For an international space station (ISS), orbit predictions for the next few days are publicized on the following websites, which may be useful for obtaining information on time and degree of orbit change.

- Information on international space stations (ISS) (NASA/Human Space Flight)
  <https://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/JavaSSOP/orbit/ISS/SVPOST.html>

6.3.10. Flight capability considering the spacecraft to be loaded

Review Standards
10. Flight capability considering the spacecraft to be loaded - The flight capability of the launch vehicle can provide the ability to put the spacecraft into the planned orbit. - Safety-critical systems, etc. of the launch vehicle which constitute the function to ensure the safety of the vicinity of the trajectory and launch site will not receive any severe adverse effect by the spacecraft onboard the launch vehicle.

Establish a flight plan describing the system configuration, proportion of propellants, flight sequence of event, nominal and dispersed trajectories, orbit for spacecraft and flight safety operation. For the nominal and dispersed trajectories, also indicate the conditions of calculation and data used.

Safety critical systems, etc. constituting the functions to ensure the safety of the vicinity of the trajectory and launch site of the launch vehicle include the following:

- Flight termination system
- Systems necessary for the decision on whether the flight termination is necessary.

In relation to the effect on safety critical systems, etc. caused by a spacecraft to be loaded, consider the following factors and show the results of assessment that the launch vehicle or spacecraft is tolerant.

- Structural failure due to insufficient strength
- EMI (Electro Magnetic Interference)
- Inadvertent deployment of deployment mechanisms such as solar array paddles
- Propellant leakage from the spacecraft
- Breakup due to anomalies including malfunctions of the battery and heat pipe of the spacecraft

6.3.11. Verification of feasibility for flight considering meteorological conditions

Review Standards
11. Confirmation of feasibility for flight considering weather conditions - The applicant, immediately before the launch, confirms that the launch vehicle will not deviate from the planned trajectory and planned impact area due to the effect of weather conditions. - The applicant avoids any circumstances that may result in third-party damage, including a failure of equipment due to lightning, by predicting the possibility of lightning on the course of the trajectory.

In the application phase, clearly specify the means of verification and flight commit criteria, and indicate in the plan that the feasibility for flight is to be finally confirmed as compliant with the flight commit criteria and that the launch will be suspended or rescheduled if any problem is expected.

The following is an example of weather conditions that may have impact on the prevention of third-party damages caused by launch. Determine the criteria for the Go/No-go decision. However, this does not apply to the case where the following matters are not necessary to ensure public safety because of the characteristics of launch vehicle and launch site and measures of flight termination, etc.

(1) Restriction related to wind condition at relatively low altitude

- Interference between the launch vehicle and launch pad facility during the lift off to clearing the launch pad.
- Normal operation of tracking antennas (in cases of flight termination by

receiving a signal transmitted from the ground)

(2) Restrictions related to rain, humidity and temperature
- Ensuring of normal flight capability of the launch vehicle
- Ensuring the appropriate tracking of launch vehicle (in cases of flight termination by receiving a signal transmitted from the ground)

(3) The presence of any thunder cloud or frozen layer around the planned trajectory

(4) Occurrence of earthquake, tsunami, etc. in the vicinity of the launch site (related facilities including a launcher and tracking station)

(5) Obstruction of normal flight safety operation due to lighting, direct light and fog

(6) Applicability of winds (in particular, winds aloft) on the launch day to a flight plan and flight safety operation
- Whether or not there is any deviation from the conditions at the time of the determination of the planned impact area for jettisoned objects (6.3.4.1), air restricted area (6.3.6.2) and trajectory (6.3.4.1).
- Whether or not the launch vehicle in normal flight violates the flight termination criteria

Note) For the confirmation, consider uncertainty due to the dwell time from the observation to the launch.

6.3.12. Prevention of third-party damage prior to the termination of restricted areas

Review Standards
12. Prevention of third-party damage prior to the termination of designation of restricted areas
- During the launch operation period, the applicant takes safety measures as necessary, including the suspension of the operation.

Establish measures to prevent third-party damages including suspension of launch process, and conditions therefor.

For devising the plan, list the events requiring the suspension of procedure or rescheduling of launch. Devise a plan so as to prevent third-party damages by suspending or rescheduling the launch if any problem is expected. The following are the major events requiring the suspension of launch.

(1) Where it is determined that the normal flight safety operation may be adversely effected by the malfunction of launch vehicle or ground systems, human errors, exogenous radio wave which may interfere with flight termination equipment, or decrease of accuracy of tracking function to be used for the flight safety

operation.

(2) Where a third party, ship or aircraft enters the restricted area and it is determined difficult to evacuate them before the launch.

(3) Where any problem is found in relation to the facilities and works relating to security, and it is determined that continuing the work and launch may involve potential risks to third parties.

(4) Where any security problem, including information, is found, and it is determined that continuing the work and launch may involve potential risks to third parties.

(5) Where there is any problem with notification and announcement to the related organizations (6.3.8) and procedures under laws and regulations.

(6) Where any interference with a manned spacecraft, etc. is expected to occur (6.3.9).

(7) Where there is any problem with the feasibility for flight on the trajectory, taking into consideration weather conditions (6.3.11).

(8) In other case where there is any problem that may render it impossible to maintain the normal system for the launch.

If the designation of a restricted area is to be terminated after the suspension of operation, rescheduling of launch, completion of launch and termination of flight, prepare schedules and written procedures paying due consideration to safety, and indicate in the plan that the applicant will implement these schedules and procedures accordingly.

In particular, if it is determined impossible to implement the launching during the lift-off count down sequence and the sequence is aborted, implement measures to ensure safety, such as turning off pyrotechnic devices and venting liquid fuels onboard the launch vehicle subjected to the flight termination.

6.3.13. Implementation of flight safety operation

Review Standards

13. Implementation of flight safety operation

- The applicant takes measures for the monitoring of the conditions of the launch vehicle in flight and ensures that the flight can be terminated in a safe manner if necessary, so as to ensure the safety against falling objects in the case of a failure of the launch vehicle.

In some cases, it is necessary to obtain information and execute the flight termination according to the conditions for the execution of flight termination as set out in 6.3.14 throughout the period of implementation of flight safety operation. However, this does not apply to the period for which it can be considered unnecessary to execute a flight termination.
The necessary information is as follows:

- Position and velocity information of the launch vehicle
- Information on health check of launch vehicle (propulsion system and navigation and guidance system)
- Information on the health check of flight termination system (launch vehicle and ground systems)

In case where a flight termination is executed by way of receiving a signal transmitted from the ground, ensure the RF link so as to ensure the implementation of flight termination measures.

In relation to the means to identify the status, information may be obtained via a spacecraft, aircraft, flying balloon, etc. in addition to the direct transmission from the launch vehicle. In this case, indicate the communication route related to the spacecraft, aircraft, flying balloon, etc. to be used.
Take measures after conducting a sufficient study of disabling factors of the flight safety operation due to the loss of data, including malfunctions.
In order to confirm that airborne equipment, pyrotechnic devices and ground facilities related to flight safety are in good condition before the launch, indicate a plan for maintenance and inspection of these equipment and facilities, including an end-to-end test from the ground facilities to equipment loaded on a launch vehicle.

6.3.14. Execution of flight termination

Review Standards

14. Implementation of flight termination

- The applicant terminates the flight of the launch vehicle in any of the following cases:

(i) When the estimated impact area of the launch vehicle and its fragments may cross the impact limit line; provided, however, that this does not apply to the case where the estimated impact area of the launch vehicle flying over the scheduled flight range passes the impact limit line, and where the flight is normal under the sufficient monitoring of the flight conditions immediately before the passage.

(ii) When it is impossible to monitor the estimated impact area of the launch vehicle, and there is a risk that the estimated impact area of the launch vehicle and its fragments may cross the impact limit line.
(iii) When there is a possibility of loss of the flight termination function of the launch vehicle, and there is a risk that the estimated impact area of the launch vehicle and its fragments may cross the impact limit line.
(iv) In other cases where any risk is considered to exist which may cause any adverse effect on the ensuring of safety if the thrust flight of the launch vehicle is continued.

It is necessary to terminate the flight of launch vehicle if there is any possibility which may result in damage to public safety and property due to abnormal flight, etc. of a launch vehicle.
In the plan, indicate that the applicant sets the conditions for the execution of flight termination appropriate to the functions of the launch vehicle or launch site for flight termination in a way enabling clear decision-making as to the implementation thereof, according to the conditions for the execution of flight termination as set out in the flight termination criteria, and implements the flight safety operation at the time of launch according to the plan. In this case, the following factors must be taken into account depending on the methods of flight termination.

In case where a flight termination is executed by way of receiving a signal transmitted from the ground

- Delay of time from the measurement of data by the vehicle or ground system to the flight termination, and the range of flight of the vehicle during that time.

In case where a flight termination is executed based on the decision by airborne system:

- Delay of time from the measurement of data by the vehicle to the flight termination, and the dispersion of flight of the vehicle during that time.

It is a ground rule to prepare the flight plan so that the expected impact area of the launching vehicle flying within the planned flight area (see Figure 1) does not interfere with the impact limit line in the vicinity of the launch site and must not interfere as a possible extent in the area at downrange (see Figure 2). It is allowed that the expected impact area of the launching vehicle flying within the nominal

trajectory would pass the impact limit line when it is unavoidable to realize the flight plan in the downrange area. However, the serious events that may affect the function to continue the flight of the vehicle passing over the impact limit line (thrust cut off, separation etc.) must not happen in preparing the flight plan. In the real flight safety operation, confirmation of requirements to permit passing, such as health check of the launching vehicle before the expected impact area passes over the impact limit line, and termination of the flight must be executed if one of the requirements is not satisfied (see Figure 3). Also the requirements for permission of passage must be clarified in advance.

In relation to the estimated impact area of a launch vehicle, the following factors must be taken into consideration:

- Measuring errors of the current position and velocity of vehicle (or, in cases where the flight termination is to be executed by way of receiving a signal transmitted from the ground, tracking errors)
- Impact with the falling objects (in estimating the extent of estimated impact area, deviation of aerodynamic property of the falling objects, dispersion of wind during falling, and factors for deviation such as velocity accelerated by release of tank pressure upon break-up, etc. must be taken into account)
- Blast in case of explosion in flight
- Blast and secondary scattering caused by a secondary explosion in the case where there is a risk of explosion (secondary explosion) of propellant when the propellant falls and impacts the ground surface
- Area of dispersion of hazardous gases of which the concentration is not less than a certain level

The thresholds of damages to be taken into account for designating an estimated impact area are as follows. If these thresholds are not to be used, show evidence of the equivalent safety or appropriateness of the new thresholds.

- Collision of fragments (including secondary collision): falling area for fragments of which ballistic coefficient is 15kg/m^2 or above
- Blast wave: peak overpressure not less than 6.9 kPa (1.0 psi)
- Concentration of toxic gas: equivalent to the international standard or standard provided by a space agency of each state for each material.

For the consideration of hazardous gases, see 6.3.6.2(D).

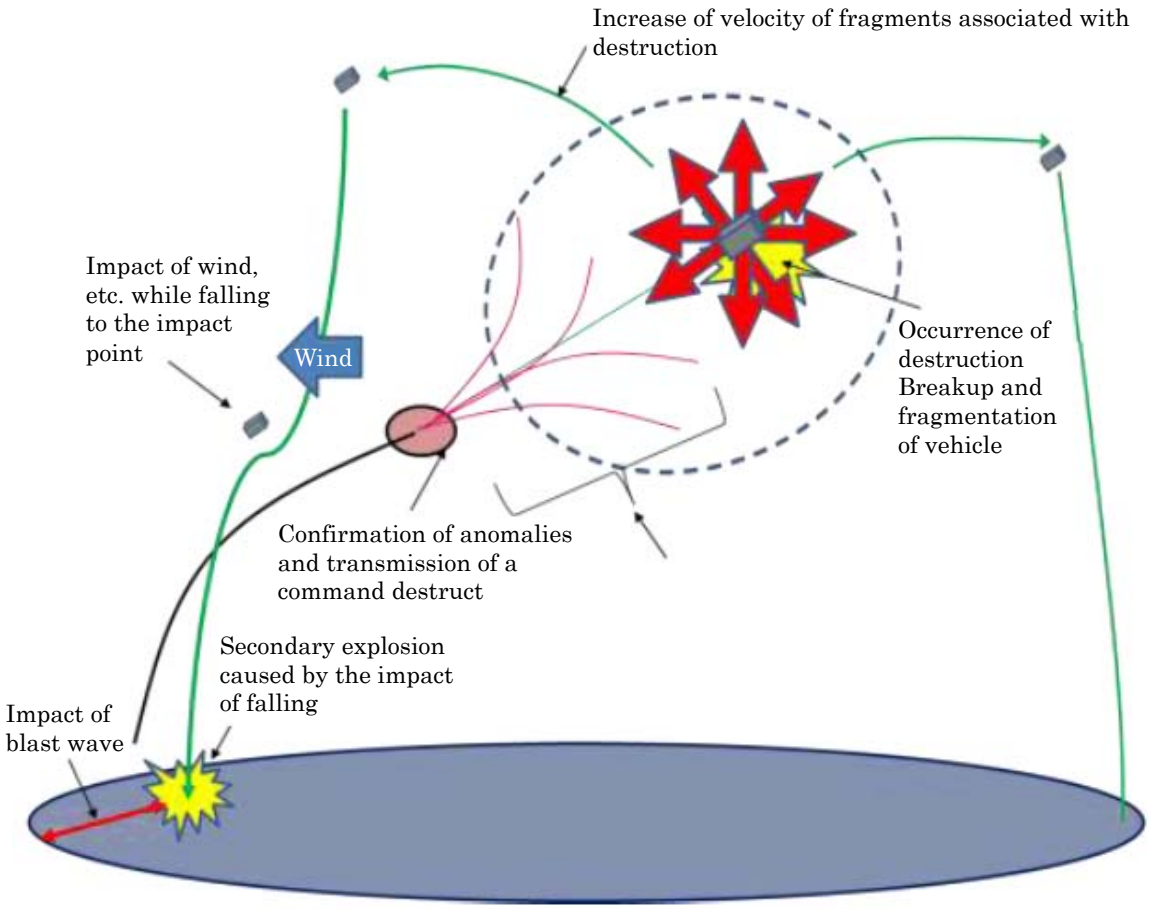

Figure 1: Concept of estimated impact area of launch vehicle

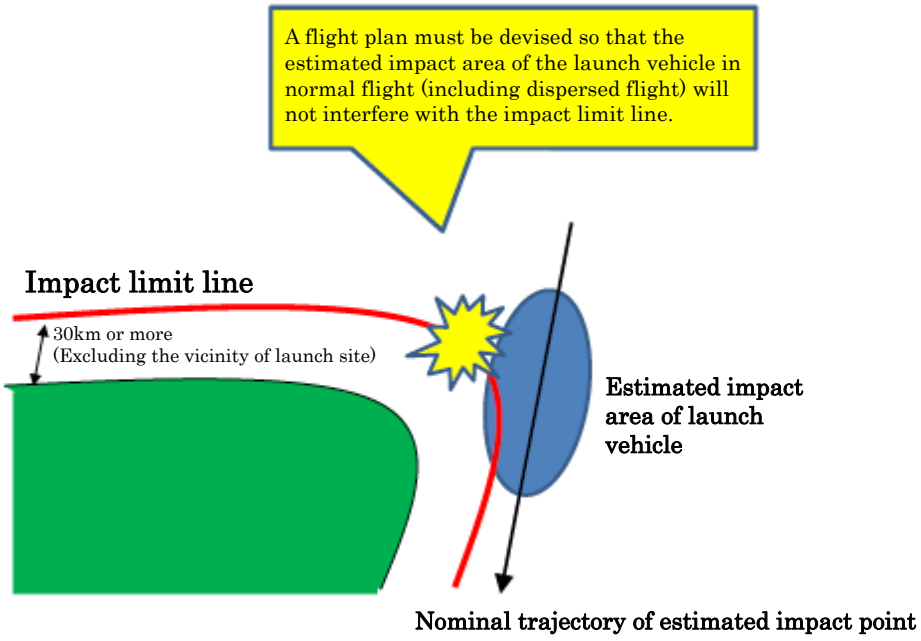

Figure 2: Estimated impact area and impact limit line (example of a trajectory generally prohibited)

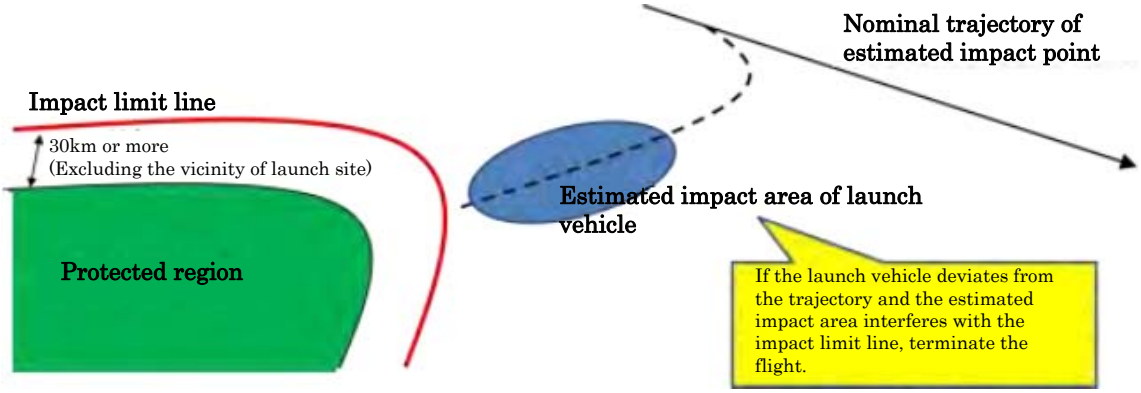

Figure 3: Estimated impact area and impact limit line (example of a case requiring termination of flight)

6.3.15. Collection of objects remaining buoyant on the sea

Review Standards
15. Retrieval of objects remaining buoyant on the sea - The applicant makes efforts to retrieve objects remaining buoyant on the sea generating from jettisoned objects from a launch vehicle which pose the risk of any severe adverse effects on the navigation of ships.

Indicate the size, materials, quantity and regions of objects remaining buoyant on the sea generated by jettisoned objects from launch vehicle, and assess the effect on the safe navigation of ships. For any objects involving risks of severe adverse effect, make a plan to retrieve them to the maximum possible extent.
If the jettisoned objects sink without floating, indicate the time before the sinking and reasons for the sinking.

6.3.16. Prevention of the occurrence of orbital debris

Review Standards
16. Mitigation of the generation of orbital debris - The applicant takes the following measures in relation to the generation of objects which may become orbital debris. (i) Take measures to prevent the unexpected activation of pyrotechnic devices for command destruction of the orbital stage of launch vehicle.

(ii) In the case of a launch vehicle for which the propellant is liquid fuel, vent the remaining propellant, gas, etc. to the possible extent, and take measures to install safety valves to avoid the increase of internal pressure or ensure the safety by way of design so as to avoid break-up even if the venting is not completed.

(i) Measures related to pyrotechnic devices for command destruction of the orbital stage of launch vehicle.

In the plan, indicate that the receiver of command destruct will be promptly turned off when there is no possibility of execution of the command destruct, so as to prevent an accidental explosion. When turning it off, make sure that the receiver will not inadvertently transmit a signal for activating any pyrotechnic devices for command destruct.

(ii) Measures related to exhaustion of residual liquid propellants and residual gases

In the plan, indicate that residual liquid propellants and residual gases at the orbital stage will be exhausted or emitted until they reach the level not causing break-up, or that there is no possibility of break-up caused by remaining fluid. More specifically, apply the following:

- Design tanks and pipelines for dual-liquid propellants so as to avoid any malfunction of a part, etc. resulting in mixing and combustion of propellants, especially in cases of a combination of self-ignition propellants.
- After the operation, when the maneuvering to transfer orbit is completed, exhaust propellants remaining in the tank and pipes. If it is impossible to exhaust both propellants due to the two-liquid propulsion system, a propellant with high self-reactivity is to be exhausted in priority.
- If it is impossible to dispose of propellants by emission, ensure sufficient safety so that there is no risk of break-up even considering heat input or install means to control the rise of internal pressure (a relief valve).
- Design the exhaustion system so that exhaustion will not be prevented due to freezing.

6.3.17. Relief of orbital stage from protected operation areas

Review Standards

17. Removal of an orbital stage of a launch vehicle from protected regions

- Where possible, the orbital stage of a launch vehicle that completed the launching into an orbit passing through a low earth orbit region (meaning a spherical region

up to the altitude of 2,000km from the Earth's surface) or an orbit that may interfere with a low earth orbit region must be transferred into an orbit for which the orbital life is shorter or must be disposed of by a reentry in a way to prevent damage to the ground, by controlling its position, attitude and conditions.

- Where possible, eternal or periodic crossing of the orbital stage of a launch vehicle and the geosynchronous orbit region (geostationary earth orbit altitude of 35,786km ±200km and latitude within ±15 degrees) is to be avoided.

Analyze whether the orbital stage interferes with the low earth orbit protected region or geostationary earth orbit protected region.

If the orbital stage interferes with the low earth orbit protected region, indicate in the plan that the applicant intends to implement the following measures:

- A transfer to another orbit so that the orbital lifetime will be 25 years or shorter, or reentry to the Earth.
- In cases where a controlled reentry is not implemented, calculate the expected casualties due to surviving objects after passing the atmosphere, and show that the value thereof does not exceed the international standard specified in the Conditions for Calculating Number of Expected Casualties and Its Methods (Launch Vehicles) attached to these Guidelines. If the value of the expected casualties does not satisfy the criteria, consider implementing a controlled reentry to the possible extent.
- Implement the following measures in case of a controlled reentry.
  (1) Clarification of the expected reentry area (an area covering the range of falling of the orbital stage and fragments)
  (2) Determination of conditions for enabling the implementation of reentry (including the avoidance of collision with manned spacecraft, etc.)
  (3) Calculation of expected casualties upon the controlled reentry
  (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)

If the orbital stage interferes with the geostationary earth orbit protected region, indicate in the plan that the applicant intends to implement the following measures:

- Avoid an eternal or periodic contact with a geosynchronous orbit region by transferring the obit.

6.3.18. Establishment of organizational structure for the implementation of launch plan

Review Standards

18. Establishment of organizational structures for the implementation of launch plan

- In order to ensure the proper implementation of the measures set forth in items 1 through 17 above, appropriate organizational structures must be established as follows.
- Organization for safety and its duties
  The applicant establishes an organization dedicated to the ensuring of safety, takes measures to ensure that the organization will function in an organic way through closely connected means of communication, and establishes a reporting structure so that all safety issues will be communicated to the person responsible for launch.
- Implementation of safety education training
  The applicant implements safety education and training for persons engaged in launch, and ensures that these persons are fully aware of the matters relating to the ensuring of safety.
- Response to emergency
  The applicant establishes an organizational structure to accurately and immediately respond to emergencies, such as an accident occurred during the launch operation period.

In order to ensure the appropriate implementation of a launch plan referred to in 6.3.1 through 6.3.17, the applicant must develop the following structures:

– Organization for ensuring safety and duties
  Clearly explain who is in charge of respective duties as well as their roles and responsibilities, using a safety structure tree, etc.
  For example, describe the following information:
  - A launch operator must establish an organization responsible for the ensuring of safety and to ensure the ground safety and flight safety under the supervision of a person responsible for launch safety.
  - For ensuring ground safety, appoint a person to supervise the duties related to ensuring the safety and security of the vicinity of the launch site as well as the maintenance and operation of facilities and equipment necessary for these.
  - A supervisor in charge of implementing the flight safety measures supervises the duties relating to the flight safety as well as the maintenance and

operation of facilities and equipment necessary for these.
- Indicate the roles and responsibilities of officers and employees in the organizational tree.
- Show that each responsible person is appropriate for launching a launch vehicle (for example, a person is equipped with ability for launch) and a training plan.

– Implementation of safety education training
  - Implement safety education and training anticipating the occurrence of accidents so as to ensure that all staff members involved are fully aware of the matters relating to the ensuring of safety.

– Response to emergency situations
  - In order to promptly respond to emergency situations during the launch preparation period, develop organizational structures such as a firefighting team and local headquarters for accident response. In addition, stipulate measures as may be necessary depending on the situations of accident (including means of communication with aircraft and ships).

6.4. Purpose and method of using the spacecraft

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 aspirations 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 (Consideration for the 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 mass destruction weapons and a spacecraft for conducting the act of terrorism does not satisfy the criteria for permission.

7. Permission, etc. related to change

Article 4 of the Act (Permission)
(2) A person who intends to obtain permission 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 design of the launch vehicle (in the case of a launch vehicle which obtained a type certification under Article 13, paragraph (1), its type certification number; or in the case of a launch vehicle certified by the government of the foreign state specified by Cabinet Office Order as having a system for the certification for designs of a launch vehicle which is considered to be of an equivalent level to that of Japan for ensuring the safety of the vicinity of the trajectory and launch site of a launch vehicle (hereinafter referred to as a "foreign certification"), to the effect that the foreign certification has been obtained);

(iii) the location of the launch site (in the case of a launch site onboard a ship or aircraft, the name or registration code of the ship or aircraft), as well as its design and equipment (in the case of a launch site which has obtained a compliance certification under Article 16, paragraph (1), the compliance certification number);

(iv) a plan setting forth the methods for the launching of the spacecraft, etc., including the schedule for launching the spacecraft, etc., the trajectory of the launch vehicle, and the method of ensuring the safety of the vicinity of the trajectory and launch site (hereinafter referred to as a "launch plan");

(v) the number of spacecraft to be placed on the launch vehicle, as well as the purposes and methods of use of the respective spacecraft; and

(vi) other matters specified by Cabinet Office Order.

Article 7 of the Act (Permission, etc. Related to Change)

(1) When a person who obtained the permission under Article 4, paragraph (1) (hereinafter referred to as a "launch operator") intends to change any matter set forth in items (ii) through (v) of paragraph (2) of that Article (including when a change has been made to the launch vehicle safety standard and the design of the launch vehicle for which the permission was granted no longer satisfies the launch vehicle safety standard, and when a change has been made to the type-specific site safety standard and the launch site for which the permission was granted no longer satisfies the type-specific site safety standard), the person must obtain permission 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.

(2) When there has been a change to any of the items set forth in Article 4, paragraph (2), item (i) or (vi), or any minor change specified by Cabinet Office Order as referred to in the proviso to the preceding paragraph, a launch operator must make a notification to the Prime Minister to that effect without delay.

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 permission or notification would be necessary are recommended to consult the NSPS in advance.

If the procedures for authorization or notification of change relating to the type certification or compliance certification have been completed prior to the application of launching, it is not necessary to submit an application for permission or notification relating to the certification in relation to the permission related to the launching.

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 4, paragraph (2), items (ii) through (v) 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

- In relation to Article 4, paragraph (2), item (ii) of the Act, refer to the Guidelines on Type Certification for Launch Vehicles.
- In relation to item (iii) of that paragraph, refer to the Guidelines on Compliance Certification for Launch Site.
- In relation to item (iv) of that paragraph, change of the trajectory.
- In relation to item (v) of that paragraph, the increase or decrease in the number of spacecraft to be loaded.

7.2. Notification of change

Article 9 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 7, paragraph (1) of the Act, are changes that would not result in a substantial change in the matters set forth in Article 4, paragraph (2), items (ii) through (v) 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 4, paragraph (2), item (i) or (vi) of the Act.
- If the change would not result in any substantial change in relation to items (ii) through (v) of that paragraph.

7.2.2. Specific examples for notification of change

- In relation to Article 4, paragraph (2), item (i) of the Act, if the launch operator is an individual, a change of name due to such reasons as marriage and change of address due to relocation, or if the launch operator is a corporation, a change of the corporate name or change of address due to relocation of its office.
- In relation to item (ii) of that paragraph, refer to the Guidelines on Type Certification for Launch Vehicles.
- In relation to item (iii) of that paragraph, refer to the Guidelines on Compliance Certification for Launch Site.
- In relation to item (iv) of that paragraph, a change in organization within the scope not affecting the execution of the launch plan.
- In relation to item (v) of that paragraph, replacement to a dummy mass in cases where the applicant obtained the permission by declaring in advance the possibility of replacement with the dummy mass in relation to the number and purpose of use of the relevant spacecraft.
- In relation to item (vi) of that paragraph, the 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 launching of spacecraft, etc. 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.