INTERNATIONAL STANDARD

ISO 14620-2

Second edition
2011-08-15

Space systems — Safety requirements —

Part 2: Launch site operations

Systèmes spatiaux — Exigences de sécurité —

Partie 2: Opérations sur le site de lancement

Reference number
ISO 14620-2:2011(E)

COPYRIGHT PROTECTED DOCUMENT

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 14620-2 was prepared by Technical Committee ISO/TC 20, *Aircraft and space vehicles*, Subcommittee SC 14, *Space systems and operations*.

This second edition cancels and replaces the first edition (ISO 14620-2:2000), which has been technically revised.

ISO 14620 consists of the following parts, under the general title *Space systems — Safety requirements*:

— *Part 1: System safety*

— *Part 2: Launch site operations*

— *Part 3: Flight safety systems*

Introduction

Space activities, carried out within the framework of outer space treaties adopted by the United Nations, may cause harm to people and create damage to public and private property and the environment. The variety of professional disciplines linked to space activities and the legal liabilities incumbent on countries require international regulations to protect Earth populations against the consequences of a possible mishap caused by these activities. The international treaties listed in Annex A define the liabilities for damage related to space activities.

This part of ISO 14620 pertains to exposed people (including populations and personnel), launch systems, manned or unmanned space vehicles, operations carried out on or from a launch site and associated procedures, natural environment, etc., during prelaunch (integration, test, checking, preparation, etc.) and launch activities.

This part of ISO 14620 is intended to be applied by any country, by any international organization, whether governmental or non-governmental, and by any operator undertaking space activities within the framework of outer space treaties adopted by the United Nations.

This part of ISO 14620 is intended to be applied by agencies, enterprises, manufacturers, customers, designers, operators, facility authorities, launch service providers, etc., participating in the activities carried out on or from a launch site, unless more restrictive requirements are imposed by the national regulations in effect on the launch site.

Space systems — Safety requirements —

Part 2: Launch site operations

1 Scope

This part of ISO 14620 specifies requirements for the safety liabilities of countries undertaking space activities or allowing operators to perform space activities on or from their territory under outer-space treaties adopted by the United Nations. It defines the safety responsibilities for the operators involved in commercial or non-commercial space launch activities. This part of ISO 14620 establishes the overall safety requirements to be observed on a launch site for prelaunch (integration, test, checking, preparation, etc.) and launch operations of a space object. It provides the basic principles to enable any operator to implement its own safety methods, tools and procedures to ensure the safety of people and personnel, public and private property, and the environment, in a consistent and uniform manner.

2 Normative reference

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 9000:2005, *Quality management systems — Fundamentals and vocabulary*

ISO 14620-1:2002, *Space systems — Safety requirements — Part 1: System safety*

ISO 14620-3:2005, *Space systems — Safety requirements — Part 3: Flight safety systems*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 9000 and the following apply.

3.1
acceptable risk
safety risk, the severity and the probability of which may be reasonably accepted by humanity, without durable or irreversible foreseeable consequence on health, Earth, and the environment, at the present time and in the future

EXAMPLE A safety risk may be acceptable for crew members of a manned space vehicle when it is comparable to that of test pilots, for the personnel participating in hazardous activities when it is comparable to that of industrial workers, for people, public and private property, and the environment, when it is comparable to that of other hazardous human activities (e.g. high-speed surface travel).

3.2
authorization
permission granted to an operator by a responsible authority to perform specified space activities

NOTE Space activities include conducting space operations, conducting launch operations, operating one or more sites, and operating one or more space vehicles on or from one or more launch sites.

3.3
damage
loss of human life, personal injury or other health impairments, occupational illness, total or partial loss of public or private property, or degradations caused to the aforesaid property or to the environment

3.4
dangerous area
area associated with a mishap or a potential mishap, inside which the consequences are catastrophic or critical

3.5
failure
termination of the ability of an item to perform the function for which it was designed

3.6
flight plan
plan related to the in-flight launch vehicle, including data directly or indirectly related to launch site safety

3.7
flight safety
arrangements intended to control safety risks from launch through the flight of a space object, and to protect people, public and private property, and the environment, against any damage that may possibly be caused by in-flight manœuvres of this space object

3.8
ground safety
arrangements intended to reduce and control safety risks identified in ground prelaunch and launch activities of a manned or unmanned space vehicle

NOTE Arrangements include protecting people, public and private property, and the environment, and completing and adjusting the national regulatory laws related to occupational safety and health, workers, environment, space, etc.

3.9
hazard
existing or potential condition of an item that can result in a mishap

NOTE This condition can be associated with the design, fabrication, operation, or environment of the item, and has the potential for mishaps.

3.10
hazardous
property of an item and its environment which provides the potential for mishaps

3.11
inhibit, noun
verifiable design feature intended to prevent a hazardous situation from occurring, that provides an interruption between an energy source and a function actuator

EXAMPLE An inhibit can be a function, a product, a hardware, a software, a physical property, or a technological device.

3.12
item
anything which can be individually described and considered

EXAMPLE An item may be an activity, an operation, a process, a procedure, a product, a system, an organization, a person, or any combination thereof.

3.13
launch
initial action to place, or attempt to place, a launch vehicle and payload, if any, in a suborbital trajectory, in Earth orbit in outer space, or otherwise in outer space

3.14
launch complex
site assigned to or owned by a launch vehicle operator to operate a launch vehicle

3.15
launch phase
period which begins when the launch vehicle is no longer in physical contact with the launch complex or the carrier aircraft and continues up to the end of the mission assigned to it including disposal and passivation actions

NOTE The launch phase ends when any planned and unplanned physical contact with the ground or destruction or breakdown of the vehicle.takes place.

3.16
launch site
site necessary for the prelaunch and launch operations of a space vehicle and for the in-flight operations during the launch phase

3.17
launch site country
country that has jurisdiction over a specified launch site

3.18
launch system
system made up of a launch vehicle, the associated launch complex, launch site, payload, ground support equipment and associated airborne equipment (including software), control systems, navigation system, trajectories, procedures, necessary personnel, and any other associated items

3.19
launch vehicle
any vehicle constructed for the purpose of operating in outer space, or placing one or more payloads in outer space, as well as any suborbital rocket

3.20
mishap
accident
unplanned event or series of events resulting in damage or potential for damage

NOTE While sometimes used synonymously, an “accident” generally means a severe type of “mishap”.

3.21
national regulatory laws
set of official statutes of a country

NOTE The official statutes include constitution, law, decree, administrative order, code, regulation, etc.

3.22
operation
technical, industrial, or implementing activity, or any combination of such activities, performed by one or more entities for the purpose of contributing to a specified objective

3.23
operator
governmental or non-governmental entities, international organization, or natural person carrying out a space operation independently and under its responsibility

3.24
payload
space vehicle or group of space vehicles on a single-launch vehicle intended to perform a specified function or series of functions

3.25
residual safety risk
safety risk associated with the hazards and/or hazardous situations remaining in a space system after eliminating hazards and hazardous situations as much as practical, and reducing the unacceptable safety risks

3.26
responsible authority
ministry, department, agency, subsection, or office of a government or international governmental organization, which is responsible for space activities including, but not limited to, launch operations in a specified location or country

3.27
risk
quantitative or qualitative measure of the severity of a potential damage and the probability of incurring that damage

3.28
safe
property of an item and its environment that limits its potential for damage to an acceptable risk

3.29
safety
arrangements intended to control safety risks stemming from activities contributing to the flight of a manned or unmanned space object, in order to ensure the protection of people, public and private property, and the environment, against any damage caused by these activities to the surface of Earth or to in-flight aircraft, or in atmospheric or outer space

3.30
safety risk
measure of the potential consequences of a hazard considering the probability of the associated mishap, the harm caused to people and the damage caused to public and private property and the environment

NOTE 1 The safety risk is defined to be differentiated from political, financial, industrial, project, and other risks.

NOTE 2 An example of a safety risk is the expected number of casualties.

3.31
site
land, ground/airborne/marine facilities, equipment, utilities and infrastructure assigned to or owned by an operator on a launch site

3.32
space object
space vehicle of artificial earthly origin and any of its component parts, except space debris, if any

3.33
space vehicle
manned or unmanned vehicle constructed or assembled for the purpose of manœuvring, moving, operating, or being placed in outer space

NOTE A space vehicle can be a launcher, a rocket, a payload, a space capsule, a space shuttle, a space plane, a space station, etc., or any assembled combination thereof.

3.34
specific authorized operator
entity allowed or licensed to conduct a space operation in an independent way according to relevant applicable space law

3.35
system
set of interdependent elements constituted to achieve a given objective by performing a specified function

3.36
waiver
written and duly signed authorization given on an occasional, exceptional, provisional and limited basis, relative to the acceptance of a hazardous item that does not comply with the applicable safety regulations or rules

4 Operator's safety responsibilities

4.1 General

The following subclauses define the general allocation of the safety responsibilities and requirements for the prelaunch (integration, test, checking, preparation, etc.) and launch operations related to a launch system. It is understood, in this part of ISO 14620, that each operator is either duly authorized or entered into an appropriate contract (specific agreement, commercial contract, etc.) with a responsible authority or an authorized operator. Several operators (e.g. launch site operator, site operator, launch vehicle operator, payload operator) can operate simultaneously on the same launch site. They can be concerned either with the same launch system or with different systems.

4.2 Occupational safety and health

Any operator carrying out operations on a launch site shall respect and apply the national occupational safety and health regulations of the launch site country.

4.3 Ground and environment safety

4.3.1 Ground safety operator

Ground safety responsibilities and requirements vary among operators. Generally, the different operators should determine themselves how safety concerns should be met. However, on the same launch site, the following conditions or criteria may exist:

a) several operators can carry out hazardous operations simultaneously;

b) hazardous operations can cause harm to personnel or damage to private or public property (external to the launch site facilities) or the environment;

c) hazardous operations carried out by one operator can cause harm to personnel or property damage to another operator;

d) some hazardous operations are performed by several operators.

Therefore, ground safety responsibilities and requirements shall be allocated between a specific operator selected from all the authorized operators, the ground safety operator in this part of ISO 14620, and other operators carrying out prelaunch (integration, test, checking, preparation, etc.) or launch operations on the launch site.

4.3.2 Ground safety operator responsibilities

Some ground safety responsibilities are general enough to be specified in this part of ISO 14620.

The ground safety operator shall be approved by the national responsible authority of the launch site country to perform the activities related to its ground safety responsibilities.

The ground safety operator shall be responsible for:

a) identifying, supervising and coordinating the allocation of ground safety responsibilities and requirements among the operators;

b) specifying ground safety rules to be applied by the operators meeting one or more of the previous criteria (as described in 4.3.1) associated with the hazardous operations;

c) verifying the application of the specified rules;

d) approving the schedule of hazardous operations meeting one or more of the previous criteria (as described in 4.3.1);

e) reviewing and approving the procedures of hazardous operations meeting one or more of the previous criteria b), c) and d) and as described in 4.3.1;

f) supervising and coordinating hazardous operations meeting one or more of the previous criteria (as described in 4.3.1);

g) verifying that the emergency plans of the operators performing hazardous operations meeting one or more of the previous criteria (as described in 4.3.1) are consistent and in accordance with the approved emergency procedures;

h) defining the general safety training (as required in 6.6.2);

i) verifying and ensuring that the safety training of each operator is consistent and homogeneous with all the other training;

j) implementing resolutions for conflicts arising among the operators from hazardous operations;

k) coordinating with, and notifying, local government authorities, as appropriate, on all matters affecting public safety and environmental protection;

l) reporting any incident or accident to affected authorities (including local government authorities), and participating in mishap investigations and finding documentation;

m) communicating the safety lessons learned to the other operators;

n) setting up a ground safety organization capable of performing ground safety responsibilities;

o) developing and maintaining a consistent environmental safety policy that meets the regulatory requirements of the launch site country.

4.3.3 Operator responsibilities

Each operator (e.g. launch site operator, specific site operator, launch vehicle operator, payload operator) on a launch site shall be responsible for:

a) protecting personnel, property and the environment from any damage caused by its own hazardous items;

b) applying the ground safety rules issued from the ground safety operator;

c) developing, implementing, maintaining, taking into account, and abiding by its own ground safety rules, consistent with the other ground safety rules and the applicable national regulations (occupational safety and health, workers, environment, space, etc.);

d) accepting the allocation of the appropriate ground safety responsibilities from the ground safety operator;

e) defining and implementing the associated ground safety arrangements that ensure the ground safety risks inherent in its operations are compatible with the stated safety objectives (as required in 5.3) and are safely controlled;

f) identifying the hazards and hazardous situations and assessing the associated ground safety risks by performing hazard analysis on its space vehicles, sites and operations, and eliminating the hazards and hazardous situations or reducing the unacceptable ground safety risks;

g) managing the residual ground safety risks inherent in its space vehicles, sites and operations (including procedures and personnel) to achieve safe operations;

h) performing the necessary functions to ensure safe operations;

i) developing, verifying, implementing and maintaining an emergency plan for the mishaps that can occur during its own hazardous operations;

j) participating in mishap investigations as required by the ground or flight safety operator;

k) defining and providing the specific safety training by site (as required in 6.6.3) related to its operations;

l) verifying that any worker has a valid safety accreditation (as required in 6.6.5) before beginning any hazardous operation;

m) setting up a ground safety organization capable of performing its ground safety responsibilities.

If the ground safety rules of a launch site and the occupational safety and health regulations of the country of a foreign operator performing space activities on this launch site are in conflict, then the former takes precedence over the latter for this operator and its workers participating in activities carried out on or from the launch site. However, exceptions can be made for specific cases duly accepted by the suitable national responsible authority of the launch site country.

Ground safety rules of an operator performing space activities on or from a launch site may exceed the launch site country's own occupational safety and health regulations.

Any operator carrying out operations on a launch site shall respect and apply the territorial and national relevant regulations.

4.4 Flight safety

4.4.1 Flight safety operator

The allocation of the flight safety responsibilities and requirements among various operators may vary. However, on the same launch site, the flight safety responsibilities and requirements shall be allocated only between a specific authorized operator, the flight safety operator in this part of ISO 14620, and each space vehicle operator carrying out prelaunch (integration, test, checking, preparation, etc.) or launch operations on the launch site.

4.4.2 Flight safety operator responsibilities

Some flight safety responsibilities are general enough to be specified in this part of ISO 14620.

The flight safety operator shall be approved by the national responsible authority of the launch site country to perform in-flight safety activities related to its responsibilities during the launch phase of a space vehicle.

The flight safety operator shall be responsible for:

a) protecting personnel, property and the environment from damage that may arise from a space vehicle (whether manned or unmanned) during its launch phase;

b) controlling the flight safety risks during the launch phase of a space vehicle (e.g. by using the flight safety systems required in ISO 14620-3);

c) developing and maintaining the flight safety rules to be applied to each space vehicle, consistent with the national regulatory laws (health, environment, space, etc.) and the concerned ground safety rules;

d) allocating, in accordance with the concerned space vehicle operators, the flight safety responsibilities and requirements;

e) developing, implementing, maintaining, taking into account and abiding by its own flight safety rules to be applied during the launch phase;

f) defining and implementing the associated flight safety systems (see ISO 14620-3) that ensure the flight safety risks are compatible with the stated safety objectives (as required in 5.3) and are safely controlled;

g) identifying the hazards and hazardous situations and assessing the associated flight safety risks by performing hazard analysis on these flight safety systems and intended operations and eliminating the hazards and hazardous situations or reducing the unacceptable flight safety risks;

h) managing the residual flight safety risks inherent in the launch phase;

i) verifying and ensuring that the space vehicle operators apply the specified flight safety rules and abide by their own flight safety rules;

j) approving the on-board flight safety equipment specified by the space vehicle operators;

k) approving the flight plan of a launch vehicle, including nominal and dispersed trajectories;

l) contributing to developing, verifying and implementing the emergency plans related to the launch phase;

m) reporting any incident or accident to affected authorities (including local government authorities), and participating in mishap investigations and finding documentation;

n) communicating the safety lessons learned to other operators;

o) setting up a flight safety organization capable of performing its flight safety responsibilities.

4.4.3 Space vehicle operator responsibilities

For the launch phase, each space vehicle operator (e.g. launch vehicle operator, payload operator) shall be responsible for:

a) developing, implementing, maintaining, taking into account and abiding by its own flight safety rules to be applied to its space vehicle, consistent with the flight safety operator rules;

b) accepting the allocation of the appropriate flight safety responsibilities from the flight safety operator;

c) defining and implementing the associated on-board flight safety systems (see ISO 14620-3) that ensure that the flight safety risks are compatible with the stated safety objectives (as required in 5.3) and allow the flight safety operator to ensure that the flight safety risks will be safely controlled;

d) submitting these arrangements and equipment to the flight safety operator for approval;

e) submitting the flight plan of its launch vehicle, including nominal and dispersed trajectories, to the flight safety operator for approval;

f) applying the flight safety rules specified by the flight safety operator;

g) identifying the hazards and hazardous situations and assessing the associated flight safety risks by performing hazard analysis on its space vehicle and intended operations, and eliminating the hazards and hazardous situations or reducing the unacceptable flight safety risks;

h) participating in mishap investigations as required by the ground or flight safety operator.

5 Launch safety requirements

5.1 Safety risk expressions

General launch safety requirements are both qualitative and quantitative expressions of the safety risk associated with each mishap that can occur during the prelaunch (integration, test, checking, preparation, etc.) and launch operations of a space vehicle. They include:

a) a description of the consequences of the mishap (hazard severity);

b) the probability of the mishap occurring, regarded as being the maximum acceptable value (risk probability);

c) qualitative prevention rules to avoid mishap.

5.2 Severity classes

5.2.1 The consequences of hazards are ordered in severity classes, which shall include:

a) catastrophic hazard: taking into account, as a minimum, the loss of human life as the first priority;

b) critical hazard: taking into account, as a minimum, serious injury as the first priority, but not life-threatening injury.

5.2.2 When necessary, more precise information shall be specified in compliance with the severity classes defined in ISO 14620-1.

5.3 Quantitative safety objectives

The quantitative safety objective is the maximum value of the acceptable safety risk. The quantitative safety objectives of hazardous systems with catastrophic or critical hazard related to a launch site should be established by the national responsible authority of the launch site country or by its authorized operators. These objectives, if any, shall be compliant with the international and national regulations.

During the launch phase of a space vehicle, the in-flight safety objective for the exposed ground population and property should be established to achieve the lowest practicable level of safety risk. This objective should be comparable to the objective defined for other hazardous human activities (e.g. civil air transport), if any, and should allow the flight safety operator to define and implement the arrangements, facilities and equipment necessary to control the flight safety risks in the safest manner.

5.4 Qualitative safety principles

5.4.1 The main objective of safety rules is to ensure that ground safety and flight safety, during hazardous activities carried out on or from a launch site, protect human life as the first priority.

5.4.2 In the event of emergency, the uninvolved launch site personnel (ground personnel, in-flight aircraft personnel, etc.) shall be protected before the personnel on a manned space vehicle.

5.4.3 Any hazardous item operated on or from a launch site shall be analysed to identify hazards and hazardous situations as well as assess associated safety risks.

5.4.4 In order to prevent mishaps, inhibits shall be introduced into hazardous systems operated on or from a launch site. The inhibits preventing the same mishap shall be independent (meaning that no single failure can eliminate more than one of them) and of a different kind. The procedures shall be designed so that these inhibits cannot be removed simultaneously by a single command, a single failure, or a common environment.

5.4.5 In hazardous systems operated on or from a launch site, no single failure (hardware failure, software error, etc.) shall generate a hazard or a hazardous situation whose consequences are catastrophic or critical; no combination of two failures (hardware failure, software error, etc.) shall generate a hazard or a hazardous situation whose consequences are catastrophic.

5.4.6 Before a decision relative to a hazardous item is made by the suitable authority (responsible authority, operator, space programme or project, etc.), and before this item is operated or used on or from a launch site, the concerned ground and/or flight safety organization shall be consulted for proposals that can possibly reduce safety risk.

5.4.7 When a safety risk associated with a hazardous activity carried out on or from a launch site is accepted by the responsible authority or the authorized operator, and as long as its level remains compatible with the corresponding safety objectives, the concerned safety organization should contribute its skills and assistance in defining the necessary measures to control the accepted safety risk.

5.4.8 A file shall be maintained on site providing the specifications of all hazardous materials being used during launch site processing; this requirement shall not override or eliminate any applicable statutory requirements for the workers' protection, but may complement such a programme.

5.5 Qualitative ground safety principles

5.5.1 At each occurrence of a hazardous operation on a site or a launch site, only one operator shall be responsible for the associated ground safety operations.

5.5.2 Each operator organization shall allow its ground safety organization to be operationally independent from the organization performing hazardous operations on a site or a launch site. This independence shall be guaranteed by the concerned operator's safety rules.

5.5.3 If an operational decision is likely to create a hazard or a hazardous situation on a site, a launch site or the environment, or increase a safety risk incompatible with the safety objectives, the concerned safety organization shall oppose the decision and, if necessary, inform the manager of the site to whom it is answerable and the ground safety operator; all operators should make every reasonable effort to resolve differences in advance in the planning process.

5.5.4 Any hazardous operation performed on a site or a launch site shall be designed to be performed with the minimum personnel present inside the corresponding dangerous area.

5.5.5 To control safety risk, the concerned ground safety organization shall have the delegated authority to:

a) contribute to the design and development of a hazardous item that is to be transported to a site or a launch site to ensure compliance with the specified safety rules;

b) be informed of launch site follow-up activities to identify the tasks requiring safety resolution;

c) evaluate hazard analysis and safety allocations on all new or modified items that may possibly cause damage to a site, a launch site or the environment;

d) approve the launch safety process (described in Clause 6) before beginning hazardous operations;

e) interrupt a hazardous operation performed on a site or a launch site and maintain the halt until the system complies with the stated safety objectives.

5.5.6 Any hazardous item that can produce ionizing or non-ionizing radiation and is used on a site or a launch site shall have the authorization of the person responsible for radiation protection before transporting the item to the site or the launch site.

5.5.7 Minimization of stored quantities of hazardous materials on a launch site (e.g. chemicals, cryogens, radioactive or pyrotechnic products) reduces actual and potential safety risks. Site designs and operating procedures should be established and periodically reviewed to ensure that total quantities are minimized and excess quantities removed.

5.6 Qualitative flight safety principles

5.6.1 At each occurrence of the launch phase of a launch vehicle, only one operator shall be responsible for the flight safety operations performed on or from a launch site.

5.6.2 The flight safety operator of a launch site shall be operationally independent of all the space vehicle operators. This independence shall be guaranteed by the safety rules of the concerned operators.

5.6.3 The flight of a launch vehicle shall be authorized by the flight safety operator of the concerned launch site.

5.6.4 To control safety risks, either the flight safety operator of the concerned launch site shall have delegated authority or a flight termination system (see ISO 14620-3) shall be programmed on board and approved by the flight safety operator in order to interrupt the flight of a launch vehicle during the launch phase when it no longer complies with forecasts and before it becomes hazardous for populations on the ground.

5.6.5 Safety risks associated with the impact of flight space objects in water shall be compliant with the stated safety objectives.

5.6.6 The launch vehicle and any jettisoned component parts shall not impact the land or territorial waters of a country other than the launch site country, unless such an extraterritorial impact, or the possibility thereof, has been agreed to in advance by the respective nations involved. Such an agreement should clearly describe issues such as financial compensation, responsibility for recovery of items, means of notification, and responsibility for mitigation of long-term effects.

5.6.7 The on-board radioactive products that can cause damage, if released, shall be designed to remain completely enclosed during any situation that may arise during the launch phase, even in the event of an in-flight mishap.

5.6.8 The on-board nuclear reactors shall not move on to their critical state before the end of the launch phase, even in the event of an in-flight mishap.

5.6.9 The design and use of a space vehicle carrying biological or chemical experiments shall comply with the stated safety objectives and eliminate any biological or chemical hazard for people, the environment, and the atmospheric and outer space, even in the event of an in-flight mishap.

6 Launch safety process

6.1 Launch safety process requirement

In order to control safety risks, any launch site shall establish a launch safety process. The launch safety process shall be based on hazard analysis concerning hazardous items and the associated environment. It shall be iterative and continuous and take advantage of experience acquired in other launch activities. The applicable safety rules and process shall be enforced and followed. The launch safety process is described in the following subclauses.

6.2 Safety risk control

To control safety risks related to the hazardous operations performed on or from a launch site, the launch safety process shall make it possible to:

a) identify hazards and hazardous situations and assess associated safety risks;

b) eliminate hazards and hazardous situations related to unacceptable safety risks or reduce these safety risks so that they should become compatible with the stated safety objectives;

c) accept and manage residual safety risks;

d) define the arrangements that will make it possible to return to a safe situation after the occurrence of a mishap.

Experience acquired in other launch activities should be used to identify hazards and hazardous situations and assess associated safety risks early on in order to suggest methods for eliminating hazards and hazardous situations or reduce safety risks, and to simplify the process in the case of recurrent items (as indicated in 6.4).

Duties associated with safety risk control should be based on both qualitative and quantitative hazard analysis methods. All operators shall show in their reports that they follow the qualitative and quantitative safety requirements allocated to them and shall demonstrate during qualification and acceptance tests that their facilities, equipment and operations comply with the stated safety objectives. Maintaining the compliance of ground facilities and equipment with the stated safety objectives over time shall be covered by maintenance and configuration management plans.

6.3 Procedure

In order to achieve safe operations, any hazardous operation performed on or from a launch site shall be preceded by the preparation of formalized written procedures.

Procedural content shall comply with the national responsible authority requirements or, at the very least, should identify precisely the nature of the hazardous operations, the environmental conditions, the potential mishaps, hazardous situations and their possible changes, the emergency plans, the necessary safety measures, and the possible returns in a safe situation.

Procedures dealing with hazardous operations shall be identified on the document cover. Procedures shall have safety warnings in plain language clearly marked in the body of the procedure, at the appropriate step. Where required, procedures shall carry information in more than one language. Procedures shall be subject to operating hazard analysis before they are approved. Procedures shall be approved by the concerned safety organization. Thereafter, no change which modifies a risk or adds a hazard shall be made without a new approval by the same safety organization.

When a hazardous operation is to be carried out even though it has not been identified during the hazard analysis, its procedure shall be drafted by the affected operator and submitted to the concerned safety organization for approval before the operation is started.

6.4 Safety submission process

The safety submission process is a safety risk management method that enables the appropriate safety organization to ensure that:

a) the applicable safety regulations and rules are enforced and followed;

b) the stated safety objectives have been achieved;

c) operations will not generate an unacceptable safety risk, even in emergency conditions.

The safety submission process will result in the formal approval by the appropriate safety organization for any hazardous item (e.g. ground facility, test specimen, launch vehicle, on-board safety equipment, payload, flight trajectory).

The safety submission process shall consist of several steps associated with the engineering process of a space system. The following steps are considered standard steps of the safety submission process and shall be enforced.

— *feasibility*: to identify the hazards and hazardous situations of the possible system concepts and the concept which intrinsically has the lowest associated safety risks;

— *design and definition*: to eliminate hazards and hazardous situations or to mitigate the associated safety risks, to assess and accept the residual safety risks, and to identify the applicable safety requirements;

— *development and production* (including qualification): to evaluate the compliance with the safety requirements, to verify that the safety objectives are achieved, to identify and prepare the emergency plans and the safety training programme, and to develop procedures;

— *operations* (utilization): to evaluate the impact to safety of changes in design and operations and operational mishap, to ensure that the safety margins are preserved, and to operate sites and space vehicles safely.

When a recurring item is involved, the safety submission process can be simplified to take into account the experience acquired during the complete process applied to the first article.

6.5 Processing of nonconformities

6.5.1 Nonconformities apply to the stated safety regulations or rules. When they do not comply with the stated safety objectives, nonconformities shall be subject to a simple, prompt and special processing which shall be set out in detail in the safety rules or quality handbook of each operator. This processing shall include the reason why the residual nonconformity requires a waiver request, the rationale for the acceptance of a residual

safety risk, the formal evaluation of the nonconformity and acceptance of the waiver. A permanent record of the evaluation of the nonconformity and acceptance of the waiver shall be maintained.

6.5.2 When a nonconformity deviates from a safety requirement, a waiver shall be processed through the safety organization concerned for approval by the authority that requires the corresponding requirement (e.g. national responsible authority, launch site organization).

6.6 Safety training

6.6.1 General requirements

6.6.1.1 The launch site management staff shall organize practical safety training suited to hazards and hazardous situations present on the launch site and formalized by safety qualification certification. This training shall be adapted to the changes of hazards and hazardous situations and safety risks and to the occurrence of mishaps. It should be periodically repeated according to conditions specified in the launch site safety rules. The content and method of this training should be periodically reviewed and updated.

6.6.1.2 The safety rules of an operator shall provide detailed objectives of the three training levels given in 6.6.2 to 6.6.4. The contents of each level shall be verified by the ground safety operator. The safety qualification certification awarded by an employer to personnel who have completed a safety training course shall specify the level and the limit of its validity.

6.6.1.3 Any permanent or temporary worker having unescorted access to the launch site shall have previously received one or more of these three levels of training.

6.6.1.4 All training shall be done in the operators' or workers' native language or in a language understood by them.

6.6.2 General safety training

General safety training shall be given to every worker of a launch site by the ground safety operator. Where appropriate, this shall also include temporary and visitor categories. This first level shall allow personnel to become acquainted with the general hazards and hazardous situations that exist on the launch site, the preventive measures to be taken, the individual protection measures at their disposal, the proper responses to alarms and warnings, and the notification procedures when an unsafe situation is observed.

6.6.3 Specific safety training by site

Specific safety training by site shall instruct personnel in the inherent hazards of the hazardous operations on that site, the associated prevention and protection measures, the emergency plans, and the corresponding rescue means. This level should be provided by the site operator.

6.6.4 Particular safety training by speciality

Dedicated to each professional discipline implemented during hazardous operations on a launch site, particular safety training by speciality shall train specialists in hazardous items necessary for these hazardous operations in normal and abnormal operating conditions. This level should be provided by the specialist's employer.

6.6.5 Safety accreditation

To carry out a hazardous operation on a launch site, any qualified worker shall have a safety accreditation which should be required by the ground safety operator.

In order to be accredited, a worker shall have:

a) a health certificate if one is required by the national regulations;

b) a certificate of technical competence issued by the employer;

c) a safety qualification certificate for the level required by the position.

Only workers whose safety accreditation is valid are authorized to participate in a hazardous operation.

6.6.6 Training of personnel assigned to safety responsibilities

Before assuming their duties, safety organization personnel shall be qualified and trained to become safety professionals. The personnel should have safety education, training or experience (such as a degree in safety engineering or industrial hygiene) that is appropriate for their job responsibilities (system safety, flight safety, ground safety, occupational safety and health, etc.). Personnel shall also receive specific training for the launch safety risks, responsibilities, facilities, organization, rules, procedures, etc. The detailed contents of this specific training, depending on the responsibilities to be assumed, shall be specified in detail in the safety rules of each operator.

According to the duties assigned to them, safety organization personnel shall be trained in one or more of the following areas:

a) safety rules of one or more operators;

b) safety responsibilities and activities of each operator;

c) hazardous items on the launch site (ground facilities and equipment, space vehicles, etc.). Training should include a description of normal and abnormal operating modes of hazardous items, characteristics of these items, their hazards and the associated safety risks, prevention measures, protection measures, safety implementation circuits, intervention devices and means, etc.;

d) ground and/or flight safety systems and procedures in effect on the launch site;

e) hazards and hazardous situations identified on the launch site and associated safety risks, devices, means and procedures;

f) other areas as applicable.

Training of emergency response personnel should include active participation in simulation sessions of the normal and abnormal operating modes of hazardous items and in exercises for hazardous situations related to catastrophic or critical hazards.

6.7 Mishap investigation

6.7.1 Upon the occurrence of a mishap, the responsible national authority of the launch site country shall conduct a mishap investigation or appoint a conductor.

6.7.2 The basic intention of conducting mishap investigations is to identify root causes and learn lessons so as to prevent future mishaps. A mishap investigation shall not determine legal responsibility and liability.

6.7.3 In order to be effective, unbiased, impartial and comprehensive, the preliminary and final results of a mishap investigation shall only be released to those having a need to know. This information shall be converted into an appropriate form in order to protect the privacy of individuals involved in the mishap (e.g. no specific details or identifying information), and to ensure the integrity of the process.

6.7.4 Mishap investigations shall be conducted in accordance with applicable national regulations.

6.7.5 The authority for conducting the mishap investigation shall be appropriate to the severity and circumstances of the mishap.

6.7.6 A written “mishap investigation plan” shall be developed prior to commencing operations. This plan shall describe the process of investigating mishaps, including parties responsible for leading a mishap investigation and parties required to support the investigation. This plan may be mission-specific or generic, provided that the

plan adequately addresses every possible circumstance. When generic, the mishap investigation plan shall be subject to periodic review.

7 Safety documentation

7.1 Structure

The safety documentation of a launch site should be structured into several levels and should be maintained on site or in proximity to the launch site in a readily accessible fashion. The following examples (7.2 to 7.4) are considered as a standard structure of the launch site safety documentation and should be enforced.

7.2 Safety regulations

Safety regulations reflect the launch site country's safety policy and should be based on the basic legislation (listed in Annex A), on the launch site country's national regulatory laws and on this part of ISO 14620. Safety regulations should establish the safety liabilities and responsibilities of the operators carrying out activities on the launch site, establish the basic safety requirements and describe the general method for ensuring the requirements are followed.

7.3 Safety rules

Safety rules should set forth the parameters, requirements, methods, etc., specific to an operator carrying out activities on the launch site and should establish the safety responsibilities of its safety organization. The safety rules should agree with the safety regulations and the other safety standards in force on the launch site.

7.4 Application documents

Application documents translate the safety rules stipulated for an operator into system designs, procedures, safety instructions, operation plans, emergency plans, etc., and should make it possible for the safety organization to guarantee that the safety requirements are enforced and followed. These documents should complete and set out in detail the safety requirements associated with hazardous operations to ensure that they are carried out safely.

Annex A
(informative)

Basic legislation — International treaties and other legislative acts

A.1 General

The documents listed in A.2 to A.6 are international documents drawn up within the framework of the United Nations Organization that relate to the exploration and use of outer space.

A.2 Outer space treaty

Treaty on principles governing the activities of States in the exploration and use of outer space, including the Moon and other celestial bodies (27 January 1967). It establishes the fundamental principles governing the exploration and use of outer space and indicates the jurisdiction under which personnel on board a space object and located in outer space or on a celestial body is placed.

A.3 Rescue agreement

Agreement on the rescue of astronauts, the return of astronauts and the return of objects launched into outer space, 22 April 1968. It establishes the conditions for returning space objects discovered after impact on Earth, indicates in detail the procedures to be used by any country when notifying another country that the crew of its space object has fallen victim to an accident, is in distress, or has made a forced or involuntary touchdown or splashdown, and defines the help to be given to the crew when rescuing them and giving them necessary assistance.

A.4 Liability convention

Convention on international liability for damage caused by space objects, 29 March 1972. It establishes the principles relating to the liabilities of countries for their space activities undertaken within the framework of outer space treaties.

A.5 Registration convention

Convention on registration of objects launched into outer space, 14 January 1975. It establishes the rules to be applied and information to be provided to identify any space object located in outer space.

A.6 Moon agreement

Agreement governing the activities of states on the Moon and other celestial bodies, 18 December 1979. It establishes the rules relating to the exploration and use of the Moon and other celestial bodies within the solar system, other than the Earth.

ICS 49.140

Price based on 16 pages