International Standard

ISO 20815

Oil and gas industries including lower carbon energy — Production assurance and reliability management

Industries du pétrole et du gaz, y compris les énergies à faible teneur en carbone — Assurance production et gestion de la fiabilité

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 67, *Oil and gas industries including lower carbon energy*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 12, *Oil and gas industries including lower carbon energy*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 20815:2018), which has been technically revised.

The main changes are as follows:

— Clause 3: several new terms, definitions and abbreviated terms added;

— Clause 4: 4.1 updated, new subclause 4.1.2 added, Figure 5 and Table 2 revised;

— Main clauses and Annex A: text updated to clarify that establishment and use of production assurance programme or reliability management programme both imply conformity to this document;

— Annex B and Annex C: text updated to align with production assurance processes for life cycle phases in the revised Table 2;

— Annex A, Annex E, and Annex G: status changed to normative;

— Annex D: new text and figures added;

— Annex F: Figure F.1 revised, new text added in Clauses F.3 and F.4;

— Annex G: text updated to reflect the relationship between this document and ISO/TS 3250:2021; some text in the second edition (ISO 20815:2018) has been removed since the next edition of ISO/TS 3250 is planned to cover production loss categories for also midstream, downstream and petrochemical;

— Annex I: sequence of clauses changed; text updated in Clauses I.1, I.8 to I.9, I.14, I.16 to I.18.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

The oil and gas industries, including petrochemical and lower carbon energy activities, involve large capital expenditure (CAPEX) and operating expenditure (OPEX). The safety and profitability of the associated assets are dependent upon the reliability, availability and maintainability of the systems and components that are used. Therefore, production assurance and reliability management are essential for optimal production availability. This contributes to delivering affordable energy in a sustainable manner.

The concept of production assurance, introduced in this document, enables a common understanding with respect to use of reliability technology in the various life cycle phases. Production assurance covers the activities implemented to achieve and maintain an optimal performance level in terms of the overall economy, which is consistent with applicable regulatory requirements and framework conditions.

Oil and gas industries including lower carbon energy — Production assurance and reliability management

1 Scope

This document specifies requirements and guidance for production assurance and reliability management as applicable to the assets and operations associated with exploration drilling, exploitation, processing and transport of petroleum, petrochemical and natural gas resources. It covers the assets and associated activities for upstream, midstream, downstream and petrochemical business categories. It focuses on the production assurance of oil and gas with respect to production and associated activities and covers the analysis of reliability and maintenance of the equipment. This includes a variety of associated systems and equipment in the oil and gas value chain. Production assurance addresses not only hydrocarbon production, but also associated activities such as drilling, pipeline installation and subsea intervention.

The document also supports production assurance and reliability management for lower carbon energy assets and associated operations, e.g. carbon capture and storage (CCS), hydrogen, ammonia, and wind energy. It describes the processes, activities, requirements and guidelines for systematic management, effective planning, execution and use of production assurance and reliability technology.

This document defines 12 processes, of which seven are denoted as core production assurance processes and addressed in this document. The remaining five processes are denoted as interacting processes and while they are outside the scope of this document, information is provided as to how they relate to production assurance and reliability management. The relationship of the core production assurance processes with these interacting processes, however, is within the scope of this document as the flow of information to and from these latter processes is required to ensure that production assurance requirements are fulfilled.

The document specifies how to establish and execute a production assurance programme (PAP) and a reliability management programme (RMP).

This document lists processes and activities that can be initiated to add value for the stakeholder (e.g. operator), where the selected process can depend on their business strategy and application area.

This document is intended for the following users and associated activities by their personnel:

— Operators: Production assurance and reliability management activities. Related activities include project management and control, technology development, technology qualification, concept and system design, risk management (including HSE), integrity management, and maintenance management.

— Contractors: Activities by the main contractor for engineering, procurement, construction, drilling, installation, operation, maintenance services, etc.

— Vendors: Activities by manufacturer or supplier related to equipment design and quality management, technology development and qualification.

— Authorities: Activities by regulatory bodies to ensure HSE, resource utilization and economic efficiency in operations.

— Consultants: Consultancy services aimed at supporting production assurance and reliability management.

— Universities: Activities associated with educating industry professionals, as well as conducting fundamental or applied research projects, when related to production assurance, reliability management, and technology development. This includes improvement of the methods and frameworks described herein.

— Research institutions: Research activities related to production assurance, reliability management, and technology development. This includes equipment qualification testing and advanced engineering assessments using the methods and frameworks described herein.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 14224:2016, *Petroleum, petrochemical and natural gas industries — Collection and exchange of reliability and maintenance data for equipment*

ISO/TS 3250:2021, *Petroleum, petrochemical and natural gas industries — Calculation and reporting production efficiency in the operating phase*

ISO 15663:2021, *Petroleum, petrochemical and natural gas industries — Life cycle costing*

3 Terms, definitions and abbreviated terms

3.1 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1.1
active repair time
effective time to achieve repair of an *item* (3.1.29)

Note 1 to entry: The expectation of the effective time to repair is called MART (mean active repair time).

Note 2 to entry: ISO 14224 distinguishes between the terms mean active repair time (MART), mean time to repair (MTTR), mean time to restoration (MTTRes), and mean overall repairing time (MRT). See ISO 14224:2016, 3.59, 3,61, 3.63 and 3.64 for further details.

Note 3 to entry: The mean active repair time (MART) is defined as “expected active repair time” in ISO/TR 12489:2013, 3.1.34. See also ISO/TR 12489:2013, Figures 5 and 6.

[SOURCE: ISO 14224:2016, 3.2, modified — Notes 1 to 2 to entry have been added; notes 1 and 2 to entry have been consolidated to become note 3 to entry.]

3.1.2
asset
item (3.1.29), thing or entity that has potential or actual value to an organization

Note 1 to entry: Assets can be physical or non-physical.

Note 2 to entry: A grouping of assets referred to as an "asset system," can also be considered as an asset.

Note 3 to entry: In this document, "asset" only refers to the physical assets, which are tangible assets. An organization can also operate assets that are wholly owned or partly owned through joint ventures or other arrangements. Typically, an asset is a facility or an installation, or a group of facilities. The facility corresponds to an installation category in ISO 14224:2016, Table A.1. These installations can be subdivided into plants or units, *systems* (3.1.75), equipment classes (see ISO 14224:2016, 3.18), subunits, components, etc. as described in ISO 14224:2016, Table 2.

[SOURCE: ISO 55000:2024, 3.1.1, modified — Note 3 to entry has been added.]

3.1.3
availability
ability to be in a state to perform as required under given conditions

Note 1 to entry: For a *binary item* (3.1.6), the measure of the availability is the probability of being in *up state* (3.1.79) (i.e. in a state belonging to the up state class).

Note 2 to entry: Figure 1 shows a system that is available at time t_1 and unavailable at time t_2.

Note 3 to entry: See ISO 14224:2016, Annex C for a more detailed description and interpretation of availability.

Note 4 to entry: *Technical availability* (3.1.76) or *operational availability* (3.1.50) can be used as derived *performance measures* (3.1.51) to reflect estimated availability. Case specific definition of system availability is needed to reflect the *system* (3.1.75) being addressed.

Note 5 to entry: Further terms are given in ISO/TR 12489.

Note 6 to entry: See Figure G.1 for further information.

[SOURCE: IEC 60050-192:2015, 192-01-23, modified — Notes to entry have been replaced by the new notes 1 to 6 to entry.]

3.1.4
average availability
mean availability
$\bar{A}(t_1, t_2)$
average value of the *instantaneous availability* (3.1.26) over a given time interval (t_1, t_2)

Note 1 to entry: The average availability is the ratio between the accumulated time spent in *up state* (3.1.79) and the length of the considered period of observation. For example, Figure 1 shows the average availability of the system over the interval $[0, t_3]$ which is equal to $(\delta_1 + \delta_2 + \delta_3 + \delta_4 + \delta_5 + \delta_6 + \delta_8 + \delta_9)/t_3$, i.e. $1-\delta_7/t_3$ where δ_7/t_3 is the average unavailability of the system. This formula is similar to the formula obtained for *production availability* (3.1.59) calculations when only two levels, 100 % and 0 %, are considered.

Note 2 to entry: The average availability can be interpreted as the long-run proportion of time where the item is able to function. Mathematically speaking, the average availability is the mathematical expectation of the term *availability* (3.1.3), as this term does not have the mathematical property of a normal probability and cannot be handled as such.

[SOURCE: IEC 60050-192:2015, 192-08-05, modified — Note 1 to entry has been replaced by the new notes 1 and 2 to entry.]

3.1.5
barrier
functional grouping of safeguards or controls selected to prevent a *major accident* (3.1.40) or limit the consequences

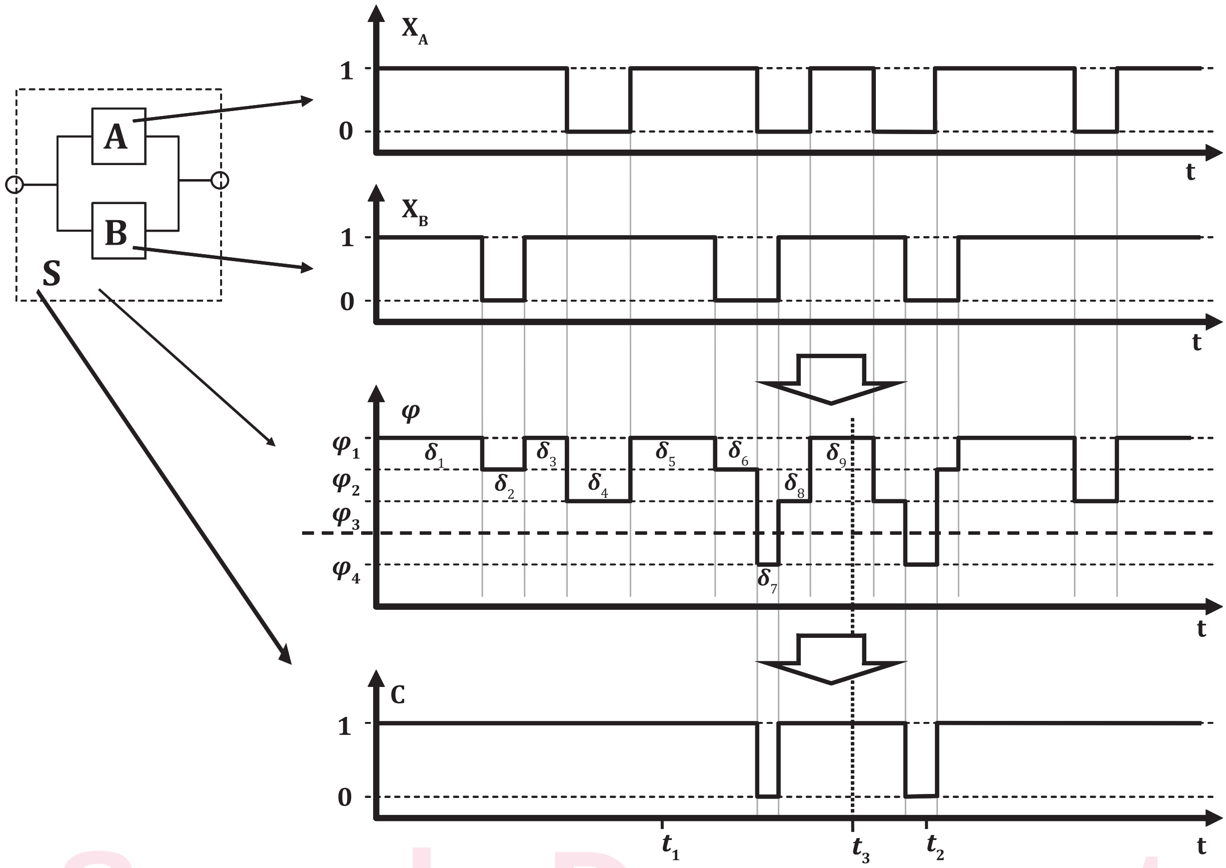
[SOURCE: ISO 17776:2016, 3.1.1, modified — Notes to entry have been removed.]

3.1.6
binary item
item (3.1.29) with two classes of states

Note 1 to entry: The two classes can be *up state* (3.1.79) and *down state* (3.1.15).

EXAMPLE 1 An item that only has an up state and a down state is a binary item. Components A and B in Figure 1 are binary items.

EXAMPLE 2 A system made up of two redundant binary items, components A and B, has four states: φ_1 (both A and B in up state), φ_2 (A in up state and B in down state), φ_3 (A in down state and B in up state), φ_4 (both A and B in down state). If the system is able to operate as required in states φ_1, φ_2 and φ_3 and not able in state φ_4, it is a binary item with the up state class $\{\varphi_1, \varphi_2, \varphi_3\}$ and the down class $\{\varphi_4\}$. This is illustrated in Figure 1.



Key

A	component A
B	component B
S	system
δ	period of time
t	time
X_A	state of component A (binary item)
X_B	state of component B (binary item)
φ	state of the system S (multi-state item)
C	class of states of system S (binary item)

NOTE The two components each have states 1 (Up) and 0 (Down). System S as a binary item has classes 1 (Up) and 0 (Down).

Figure 1 — Illustration of availability behaviour of an 1oo2 system

3.1.7
capital expenditure
CAPEX
investment used to purchase, install and commission an *asset* (3.1.2)

Note 1 to entry: See further information regarding estimation of CAPEX in ISO 15663:2021, Clause C.2.

[SOURCE: ISO 15663:2021, 3.1.7]

3.1.8
common cause failure
failure of multiple *items* (3.1.29), which would otherwise be considered independent of one another, resulting from a single cause

Note 1 to entry: Common cause failures can also be *common mode failures* (3.1.9).

Note 2 to entry: The potential for common cause failures reduces the effectiveness of system redundancy.

Note 3 to entry: It is generally accepted that the failures occur simultaneously or within a short time of each other.

Note 4 to entry: Components that fail due to a shared cause normally fail in the same functional mode. The term common mode is therefore sometimes used. It is, however, not considered to be a precise term for communicating the characteristics that describe a common cause failure.

Note 5 to entry: Explicit and implicit common mode failures are defined in ISO/TR 12489:2013, 5.4.2.

Note 6 to entry: Regarding interpretation rules for common cause failure parameters, see also ISO 14224:2016, C.1.6.

[SOURCE: IEC 60050-192:2015, 192-03-18, modified — Notes 3 through 6 to entry have been added.]

3.1.9
common mode failures
failures of different items characterized by the same failure mode

Note 1 to entry: Common mode failures can have different causes.

Note 2 to entry: Common mode failures can also be *common cause failures* (3.1.8).

Note 3 to entry: The potential for common mode failures reduces the effectiveness of system redundancy.

[SOURCE: IEC 60050-192:2015, 192-03-19]

3.1.10
condition monitoring
obtaining information about physical state or operational parameters

Note 1 to entry: Condition monitoring is used to determine when *preventive maintenance* (3.1.57) may be required.

Note 2 to entry: Condition monitoring may be conducted automatically during operation or at planned intervals.

Note 3 to entry: Condition monitoring is part of condition-based maintenance. See also ISO 14224:2016, Figure 6.

[SOURCE: IEC 60050-192:2015, 192-06-28, modified — Note 3 to entry has been replaced.]

3.1.11
corrective maintenance
maintenance (3.1.36) carried out after *fault* (3.1.23) detection to effect restoration

Note 1 to entry: See also ISO/TR 12489:2013, Figures 5 and 6, which illustrate terms used for quantifying corrective maintenance.

[SOURCE: IEC 60050-192:2015, 192-06-06, modified — Note 1 to entry has been replaced.]

3.1.12
deliverability
ratio of deliveries to planned deliveries over a specified period of time, when the effect of compensating elements, such as substitution from other producers and *downstream* (3.1.17) buffer storage, is included

Note 1 to entry: See Figure G.1 for further information.

3.1.13
design life
planned usage time for the total *system* (3.1.75)

Note 1 to entry: It is important not to confuse design life with the *mean time to failure (MTTF)* (3.1.41). Several items can fail within the design life of the system. As long as repair or replacement is feasible, the design life of the system is not affected by such failures.

Note 2 to entry: The design life is decided during the life cycle phase "Define". Design life in this document can thus mean a lifetime that can change and that can be chosen based on *production assurance* (3.1.58) activities or *life cycle costing* (3.1.30).

3.1.14
demand availability
ability of the production facility to satisfy the demand over a specified period of time

Note 1 to entry: This *performance measure* (3.1.51) expresses the fraction of time or number of times the produced volume that is exported is equal to or above demand. See also Table G.1.

3.1.15
down state
state of being unable to perform as required, due to internal *fault* (3.1.23), or *preventive maintenance* (3.1.57)

Note 1 to entry: This concept is related to a *binary item* (3.1.6), which can have several down states forming the down state class of the item. All the states in the down state class are considered to be equivalent with regard to the unavailability of the considered item.

EXAMPLE In Figure 1, the down state class of the system S comprises only one state {S_4} and the system S is in down state at time t_2.

[SOURCE: IEC 60050-192:2015, 192-02-20, modified — Note 1 to entry has been replaced, and note 2 to entry has been removed; EXAMPLE has been added.]

3.1.16
down time
time interval during which an *item* (3.1.29) is in a *down state* (3.1.15)

Note 1 to entry: The down time includes all the delays between the item failure and the restoration of its service. Down time can be either planned or unplanned (see ISO 14224:2016, Table 4).

Note 2 to entry: Down time can be equipment down time (see ISO 14224:2016, Figure 4 and Table 4), production down time (see Figures I.1 and I.2) or down time for other operations (e.g. drilling). It is important to distinguish between the equipment down time itself and the down time of the plant to which the equipment belongs.

[SOURCE: IEC 60050-192:2015, 192-02-21, modified — Notes to entry have been replaced.]

3.1.17

downstream
business category most commonly used in the petroleum industry to describe post-production processes

Note 1 to entry: See ISO 14224:2016, A.1.4 for further details.

[SOURCE: ISO 14224:2016, 3.17, modified — EXAMPLE has been removed.]

3.1.18
failure
loss of ability to perform as required

Note 1 to entry: A failure of an item is an event that results in a *fault* (3.1.23) (i.e. a state) of that item. This is illustrated in Figure 2 for a binary system S comprising two redundant components A and B.

[SOURCE: IEC 60050-192:2015, 192-03-01, modified — The notes to entry have been replaced by a new note 1 to entry.]

3.1.19
failure cause
root cause
set of circumstances that leads to *failure* (3.1.18)

Note 1 to entry: A failure cause can originate during specification, design, manufacture, installation, operation or maintenance of an item.

Note 2 to entry: See ISO 14224:2016, B.2.3 and Table B.3, which define failure causes for all equipment classes.

[SOURCE: IEC 60050-192:2015, 192-03-11, modified — Note 2 to entry has been added.]

3.1.20
failure data
data characterizing the occurrence of a *failure* (3.1.18) event

Note 1 to entry: See ISO 14224:2016, Table 6.

[SOURCE: ISO 14224:2016, 3.25]

3.1.21
failure mode
manner in which *failure* (3.1.18) occurs

Note 1 to entry: See ISO 14224:2016, Tables B.6 to B.15, on the relevant failure modes, which define failure modes to be used for each equipment class.

[SOURCE: IEC 60050-192:2015, 192-03-17, modified — The notes to entry have been replaced by a new note 1 to entry.]

3.1.22
failure rate
conditional probability per unit of time that the *item* (3.1.29) fails between t and t + dt, provided that it works over (0, t)

Note 1 to entry: See ISO 14224:2016, Clause C.3 for further explanation of the failure rate.

Note 2 to entry: This definition applies for the first *failure* (3.1.18) of *binary items* (3.1.6).

Note 3 to entry: Under the assumptions that the failure rate is constant and that the item is as good as new after repairs the failure rate can be estimated as the number of failures relative to the corresponding accumulated *up time* (3.1.80) divided by this accumulated up time. In this case this is the reciprocal of *MTTF* (3.1.41). In some cases, time can be replaced by units of use.

Note 4 to entry: The estimation of the failure rate can be based on *operating time* (3.1.49) or calendar time.

[SOURCE: ISO/TR 12489:2013, 3.1.18, modified — The symbol "$\lambda(t)$" has been removed; the notes to entry have been replaced by the new notes 1 to 4 to entry.]

3.1.23
fault
inability to perform as required, due to an internal state

EXAMPLE *Down states* (3.1.15) of items A, B and system S is illustrated in Figure 2.

Note 1 to entry: A fault of an item results from a *failure* (3.1.18), either of the item itself, or from a deficiency in an earlier stage of the life cycle, such as specification, design, manufacture or maintenance. See latent fault (ISO 14224:2016, 3.44).

Note 2 to entry: An item made of several sub-items (e.g. a system) which continues to perform as required in presence of faults of one or several sub-items is called fault tolerant.

Note 3 to entry: See also ISO/TR 12489:2013, 3.2.2.

[SOURCE: IEC 60050-192:2015, 192-04-01, modified — EXAMPLE has been added; the notes 2 to 4 to entry have been replaced by the new notes 2 and 3 to entry.]

3.1.24
fault tolerance
attribute of an *item* (3.1.29) that makes it able to perform a *required function* (3.1.69) in the presence of certain given sub-item *faults* (3.1.23)

3.1.25
human error
discrepancy between the human action taken or omitted and that intended

EXAMPLE Performing an incorrect action; omitting a required action.

Note 1 to entry: Discrepancy with intention is considered essential in determining human error; see Reference [91].

Note 2 to entry: The term "human error" is often attributed in hindsight to a human decision, action or inaction considered to be an initiator or contributory cause of a negative outcome such as loss or harm.

Note 3 to entry: In human reliability assessment, human error is defined as any member of a set of human actions or activities that exceeds some limit of acceptability, this being an out of tolerance action or *failure* (3.1.18) to act where the limits of performance are defined by the system (see Reference [88]).

Note 4 to entry: See IEC 62508 for further details.

Note 5 to entry: See also ISO/TR 12489:2013, 5.5.2.

[SOURCE: IEC 60050-192:2015, 192-03-14, modified — The words "or required" have been removed at the end of the definition; in the EXAMPLE, "miscalculation; misreading a value" have been removed; notes 1 to 5 to entry have been added.]

3.1.26
instantaneous availability
$A(t)$
probability that an *item* (3.1.29) is in a state to perform as required at a given instant

[SOURCE: IEC 60050-192:2015, 192-08-01, modified — The admitted term "point availability" has been removed; the symbol "$A(t)$" has been added.]

3.1.27
integrity
condition in which an *asset* (3.1.2) is safe and reliable for its purpose

Note 1 to entry: For some application areas, more specific terms and definitions exist, such as asset integrity, mechanical integrity, plant integrity, safety integrity (see ISO/TR 12489:2013, 3.1.2), structural integrity (see ISO 19900:—[1]), 3.58), system integrity, technical integrity and well integrity (see ISO 16530:—[2]), 3.73). These integrity terms can encompass various *failure* (3.1.18) consequences (e.g. safety, environmental, production, and operation; see ISO 14224:2016, Table C.2).

Note 2 to entry: Integrity is also defined for use in pipeline *integrity management* (3.1.28) for onshore gas infrastructure in EN 17649:2022, 3.7. see also DNV-ST-F101:2021 and ISO 19345-1:2019, 3.1.32.

Note 3 to entry: The integrity can be expressed mathematically by using specific *performance measures* (3.1.51) as described in Annex G.

[SOURCE: EN 17649:2022, 3.7, modified — Notes 1 to 3 to entry have been added.]

3.1.28
integrity management
set of processes and procedures used to proactively manage the safe, environmentally responsible and reliable service of an *asset* (3.1.2) throughout its life cycle

Note 1 to entry: The integrity management program covers a set of processes and practices used in *reliability management* (3.1.68). See e.g. ISO 19345-1:2019, 3.1.21.

1) Under preparation. Stage at the time of publication: ISO/DIS 19900:2026.

2) Under preparation. Stage at the time of publication: ISO/DIS 16530:2026.

3.1.29
item
subject being considered

Note 1 to entry: The item can be an individual part, component, device, functional unit, equipment, subsystem, or system.

Note 2 to entry: The item may consist of hardware, software, people or any combination thereof.

Note 3 to entry: In this document, item can also be plant or unit, or installation. See ISO 14224:2016, Figure 3.

[SOURCE: IEC 60050-192:2015, 192-01-01, modified — In note 1 to entry, "material", "product" and "service or process" have been removed; in note 2 to entry, "can" has been changed to "may"; note 3 to entry has been added.]

3.1.30
life cycle costing
process of evaluating the difference between the life cycle cost of two or more alternative options

Note 1 to entry: Life cycle costing can involve quantitative and qualitative assessment.

[SOURCE: ISO 15663:2021, 3.1.27, modified — Note 1 to entry has been adjusted.]

3.1.31
life cycle phase
discrete stage in the life cycle with a specified purpose

Note 1 to entry: The different life cycle phases are further described in ISO 15663:2021, 4.5.

[SOURCE: ISO 15663:2021, 3.1.28]

3.1.32
logistic delay
delay, excluding administrative delay, incurred for the provision of resources needed for a maintenance action to proceed or continue

Note 1 to entry: Logistic delays can be due to, for example, travelling to unattended installations, pending arrival of spare parts, specialists, test equipment and information, and delays due to unsuitable environmental conditions (e.g. waiting on weather).

Note 2 to entry: See also ISO/TR 12489:2013, Figure 5.

[SOURCE: IEC 60050-192:2015, 192-07-13, modified — Note 1 to entry has been replaced by the new notes 1 and 2 to entry.]

3.1.33
lost revenue
LOSTREV
income loss that occurs when generated income are less than expected due to external or internal factors

Note 1 to entry: *Production loss* (3.1.61) categories are defined in ISO/TS 3250:2021. Time loss categories are described in Clause G.3.

[SOURCE: ISO 15663:2021, 3.1.29, modified — Notes 1 and 2 to entry have been replaced by the new note 1 to entry.]

3.1.34
maintainability
ability to be retained in, or restored to a state to perform as required, under given conditions of use and *maintenance* (3.1.36)

Note 1 to entry: Given conditions would include aspects that affect maintainability, such as: location for maintenance, accessibility, maintenance procedures and maintenance resources.