International Standard

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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

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.

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.

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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.

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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.

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— 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.]

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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.]

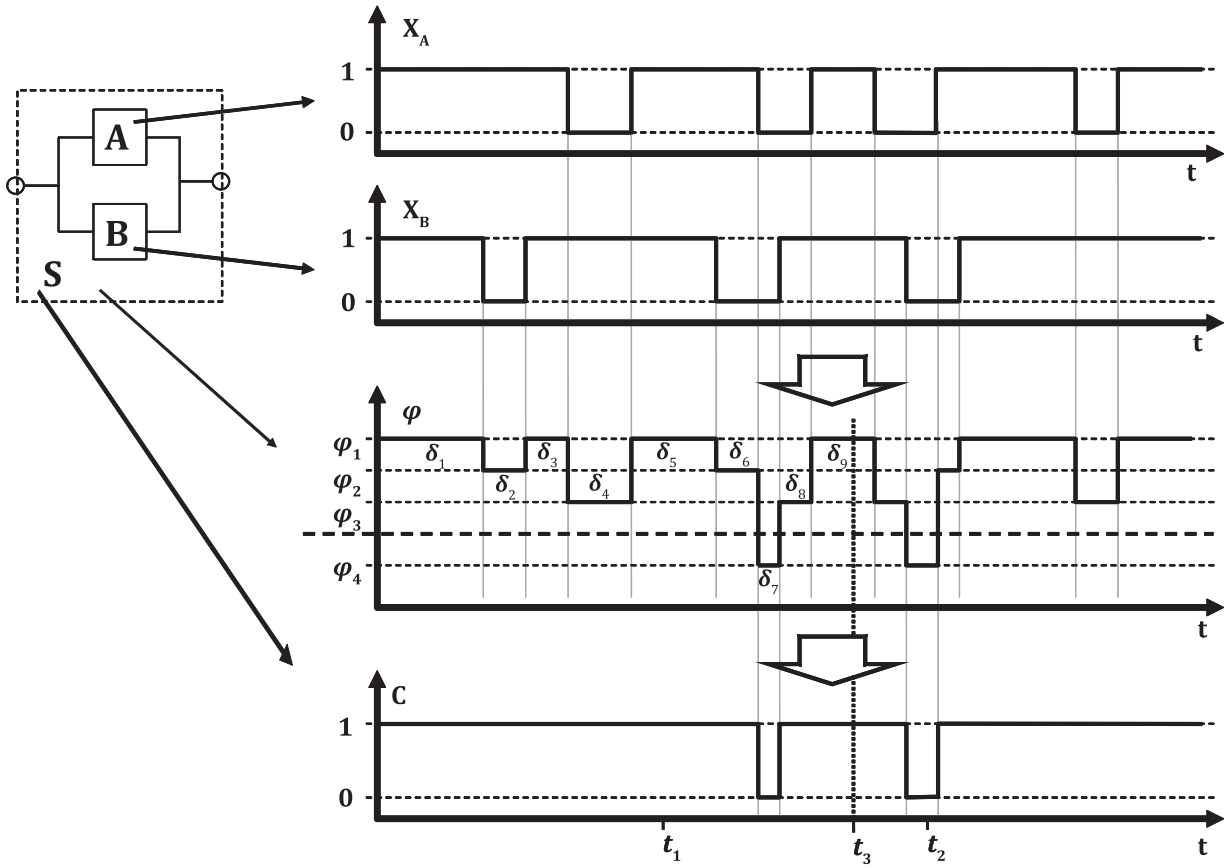
3.1.6
binary item
item (3.1.29) with two classes of states

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.

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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).

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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).

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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.]

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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)

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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.

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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.

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Note 2 to entry: Maintainability can be quantified using appropriate measures. See IEC 60050-192:2015, 192-07, Maintainability and maintenance support: measures.

Note 3 to entry: See Figure G.1 for further information.

[SOURCE: IEC 60050-192:2015, 192-01-27, modified — Note 3 to entry has been added.]

3.1.35
maintainable item
item (3.1.29) that constitutes a part or an assembly of parts that is normally the lowest level in the equipment hierarchy during *maintenance* (3.1.36)

[SOURCE: ISO 14224:2016, 3.48]

3.1.36
maintenance
combination of all technical and management actions intended to retain an item in, or restore it to, a state in which it can perform as required

[SOURCE: IEC 60050-192:2015, 192-06-01, modified — Note 1 to entry has been removed.]

3.1.37
maintenance data
data characterizing the maintenance action planned or done

Note 1 to entry: See ISO 14224:2016, Table 8.

[SOURCE: ISO 14224:2016, 3.51, modified — The notes 1 and 3 to entry have been removed; new note 1 to entry added.]

3.1.38
maintenance management
all activities of the management that determine the maintenance requirements, objectives, strategies, and responsibilities, and implementation of them by such means as maintenance planning, maintenance control and the improvement of maintenance activities and economics

[SOURCE: EN 13306:2017, 2.2]

3.1.39
maintenance supportability
ability to be supported to sustain the required *availability* (3.1.3) with a defined operational profile and given logistic and maintenance resources

Note 1 to entry: Maintenance supportability of an item result from the inherent *maintainability* (3.1.34), combined with factors external to the item that affect the relative ease of providing the required maintenance and logistic support.

Note 2 to entry: See ISO 14224:2016, Annex C for further details regarding the interpretation of maintainability.

3.1.40
major accident
hazardous event that results in

— multiple fatalities or severe injuries; or

— extensive damage to structure, installation or plant; or

— large-scale impact on the environment (e.g. persistent and severe environmental damage that can lead to loss of commercial or recreational use, loss of natural resources over a wide area or severe environmental damage that will require extensive measures to restore beneficial uses of the environment)

Note 1 to entry: In ISO 17776:2016, a major accident is the realization of a major accident hazard.

[SOURCE: ISO 17776:2016, 3.1.12, modified — The abbreviated term "MA" has been removed; note 2 to entry has been removed.]

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3.1.41
mean time to failure
MTTF
expected time before the *item* (3.1.29) fails

Note 1 to entry: See further details in ISO/TR 12489:2013, 3.1.29.

Note 2 to entry: IEC 60050-192:2015 defines MTTF as "expectation of the *operating time* (3.1.49) to failure".

Note 3 to entry: See also ISO 14224:2016, Annex C.

[SOURCE: ISO/TR 12489:2013, 3.1.29, modified — The notes to entry have been replaced by the new notes 1 to 3 to entry.]

3.1.42
midstream
business category involving the processing, storage and transportation sectors of the petroleum industry

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

[SOURCE: ISO 14224:2016, 3.65, modified — EXAMPLE has been removed.]

3.1.43
modification
combination of all technical and administrative actions intended to change an *item* (3.1.29)

Note 1 to entry: In this document, the use of the term modification is primarily meant to cover major modification activities. See further details in ISO/TS 3250:2021, 8.2.2 with respect to how such major modifications are reflected in *production efficiency* (3.1.60) reporting.

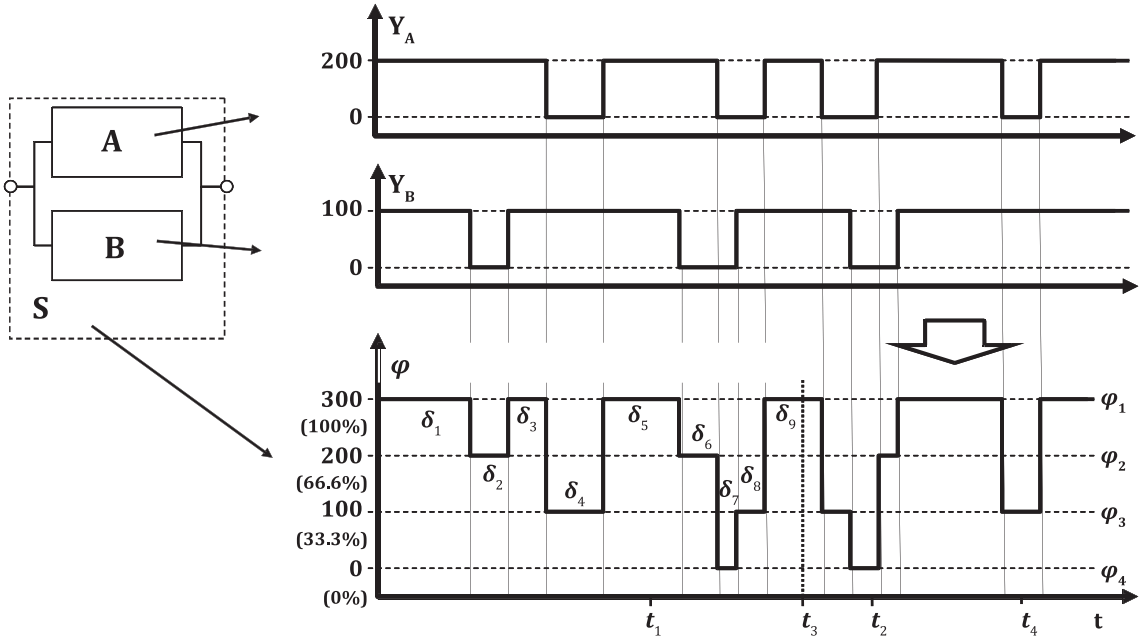
[SOURCE: ISO 14224:2016, 3.67, modified — The notes 1 to 3 to entry have been replaced by the new note 1 to entry.]

3.1.44
multi-state item
item (3.1.29) with more than two classes of states

Note 1 to entry: This is an extension of the *binary items* (3.1.6) beyond the concepts of *up state* (3.1.79) and *down state* (3.1.15). This can characterize single items with degraded states or systems made up of several components in a production facility.

EXAMPLE An oil production system comprising two wells, A and B, that can be considered as binary items 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, when they are in up state, A produces 200 bpd and B produces 100 bpd, then the system has four classes of production 300 bpd, $\{\varphi_1\}$, 200 bpd, $\{\varphi_2\}$, 100 bpd, $\{\varphi_3\}$ and 0 bpd, $\{\varphi_4\}$. With regards to oil production, it is a multi-state item. This is illustrated in Figure 2.

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Key

A	item A
B	item B
S	system
δ	period of time
Y_A	state capacity of item A (binary item)
Y_B	state capacity of item B (binary item)
φ	production output of system S (multi-state item) [in bpd]
t	time

NOTE Max X_A is 200 bpd and max X_B is 100 bpd. System S as a multi-state item has four discrete states of production output: $\{\varphi_1, \varphi_2, \varphi_3, \varphi_4\}$, where the max production output is 300 bpd.

Figure 2 — Illustration of production availability behaviour of a multi-state system

3.1.45
observation period
time period during which *production performance* (3.1.62) and *reliability data* (3.1.67) are recorded

3.1.46
on-stream availability
ability of a production facility to deliver a volume above zero 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 produced volume is above zero. See Table G.1.

3.1.47
operating expenditure
OPEX
expenses used for operation and maintenance, including associated costs such as logistics and spares

Note 1 to entry: See further information regarding estimation of OPEX in ISO 15663:2021, Clause C.3.

[SOURCE: ISO 15663:2021, 3.1.31]

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3.1.48
operating state
state of performing as required

Note 1 to entry: See ISO 14224:2016, Table 4.

Note 2 to entry: In some applications, an item in an idle state is considered to be operating.

Note 3 to entry: The *state capacities* (3.1.72) of a *multi-state item* (3.1.44) characterize various levels of operation and consequently, the definition of the operating state of a multi-state item depends on the situation, for example, if:

— no other requirement is given, any state with a capacity greater than zero is an operating state;

— a minimum capacity is required, it provides the limit to split the states between up and down classes;

— a given capacity is specified, then only the states with this capacity are operating states;

— no other requirement is given, any state with a capacity greater than zero is an operating state (300 bpd, 200 bpd and 100 bpd in Figure 2);

— a minimum capacity is required, it provides the limit to split the states between up and down classes (300 bpd, 200 bpd in Figure 2, if the minimum allowed production is 200 bpd);

— a given capacity is specified, then only the states with this capacity are operating states (200 bpd in Figure 2 if and only if 200 bpd are required).

[SOURCE: IEC 60050-192:2015, 192-02-04, modified — The notes to entry have been replaced by the new notes 1 and 3 to entry.]

3.1.49
operating time
time interval during which an *item* (3.1.29) is in an *operating state* (3.1.48)

Note 1 to entry: The accumulated times of various disjunct operating times interrupted by e.g. unplanned or planned *down time* (3.1.16) is also called operating time.

Note 2 to entry: Sometimes the term "running time" is used instead of "operating time". Often the running time describes the active part of the operating time, see ISO 14224:2016, Table 4. Whether rundown or start-up period is included depends on equipment, but hot-standby time is not included even though some equipment functions can be active to minimize start-up time in e.g. redundant configuration (hot standby).

Note 3 to entry: Running hours during testing is also called running hours, even though this is at test conditions.

[SOURCE: IEC 60050-192:2015, 192-02-05, modified — Note 1 to entry has been replaced by notes 1 to 3 to entry.]

3.1.50
operational availability
availability (3.1.3) experienced under actual conditions of operation and *maintenance* (3.1.36)

Note 1 to entry: Operational availability is determined considering *down time* (3.1.16) due to *failures* (3.1.18) and associated mobilization time (see ISO 14224:2016, 3.66), but excluding external causes. This down time represents *maintainability* (3.1.34) and *maintenance supportability* (3.1.39); see Figure G.1.

Note 2 to entry: The planned down time [for *preventive maintenance* (3.1.57) activities] and unplanned down time [i.e. mean active repair time (MART; see ISO 14224:2016, 3.59) plus mobilization time] for *corrective maintenance* (3.1.11) are included in the operational availability calculations. When such mobilization for preparation and delay for repair resources is included, the unplanned down time equals the mean overall repairing time (MRT, see ISO 14224:2016, 3.61). See ISO/TR 12489:2013, Figure 5.

[SOURCE: IEC 60050-192:2015, 192-08-03, modified — Note 1 to entry have been extended; note to 2 to entry has been added.]

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3.1.51
performance measure
quantitative expression describing the performance of an *item* (3.1.29)

Note 1 to entry: In this document various performance measures are specified for *production assurance* (3.1.58) and *reliability management* (3.1.68) purposes. A performance measure can be a term used as *performance requirement* (3.1.53) or *performance objective* (3.1.52).

Note 2 to entry: Recommended performance measures for time-based and volume-based production assurance are given in Table G.1.

Note 3 to entry: Performance measures cover both technical and operational functions. See D.3.4.1.

3.1.52
performance objective
indicative level for the desired performance

Note 1 to entry: Objectives are expressed in qualitative or quantitative terms. Objectives are not absolute requirements and may be modified based on cost or technical constraints. See further details in Annex F.

3.1.53
performance requirement
required minimum level for the performance of the *system* (3.1.75)

Note 1 to entry: Requirements are normally expressed in quantitative terms, but may also be expressed in qualitative terms.

3.1.54
periodic tests
planned operation performed at constant time intervals in order to detect the potential hidden failures which can have occurred in the meantime

Note 1 to entry: The unsafe hidden failures of a safety system which are not detected by the diagnostic tests can be detected by periodic tests. Such tests are named “proof tests” in the standards dealing with functional safety (e.g. IEC 61508-4:2010, 3.8.5).

Note 2 to entry: See ISO/TR 12489 for further details.

[SOURCE: ISO/TR 12489:2013, 3.4.8, modified – Note 2 to entry has been added.]

3.1.55
petrochemical
business category producing chemicals derived from petroleum and used as feedstock for the manufacture of a variety of plastics and other related products

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

[SOURCE: ISO 14224:2016, 3.75, modified — EXAMPLE has been removed.]

3.1.56
plant production capacity
maximum processed volume through the plant that can be achieved in the absence of any failure, interruption or any other event

Note 1 to entry: The plant production capacity is related to the product used for production efficiency calculation. The plant production capacity can be limited by the capacity of systems handling other product streams, e.g. condensate, gas or produced water, or by the capacity of utility systems.

Note 2 to entry: The plant production capacity can vary over time.

Note 3 to entry: The plant represents the *systems* (3.1.75) between the elements well and export as illustrated in ISO/TS 3250:2021, Figure 5.

[SOURCE: ISO/TS 3250:2021, 3.1.34]

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3.1.57
preventive maintenance
maintenance (3.1.36) carried out to mitigate degradation and reduce the probability of *failure* (3.1.18)

[SOURCE: IEC 60050-192:2015, 192-06-05, modified — The preferred term "preventative maintenance" has been removed; notes 1 and 2 to entry have been removed.]

3.1.58
production assurance
activities implemented to achieve and maintain a performance that is at its optimum in terms of the overall economy and at the same time consistent with applicable framework conditions

Note 1 to entry: Production assurance in this document is not only limited to cover production of oil and gas. It can also be other activities such as drilling operations, downhole well intervention, subsea intervention, offshore loading operations, for which production assurance activities and *reliability management* (3.1.68) are needed.

Note 2 to entry: Production assurance activities relate closely to the *integrity management* (3.1.28) of the installations.

3.1.59
production availability
A_P
ratio of production to planned production, or any other reference level, over a specified period of time

Note 1 to entry: Production availability is an extension of the *average availability* (3.1.4) to deal with *multi-state items* (3.1.44). Reference is made to production volume, i.e., the ability to achieve the planned production or some reference level at time t, where the planned production level is defined according to user needs. The ratio between the accumulated production delivered over a given interval of time and a reference production level defined for this interval. For example, Figure 2 shows the production availability of the system over the interval $[0, t_3]$ is equal to $[300 \cdot (\delta 1 + \delta_3 + \delta_5 + \delta_9) + 200 \cdot (\delta_2 + \delta_6) + 100 \cdot (\delta_4 + \delta_8)] / (300 \cdot t_3)$ provided the reference production level is 300 bpd at any time. By dividing by 300, this formula can also be written $[(\delta_1 + \delta_3 + \delta_5 + \delta_9) + 66{,}6\,\% \cdot (\delta_2 + \delta_6) + 33{,}3\,\% \cdot (\delta_4 + \delta_8)] / t_3$.

Note 2 to entry: This measure is used in conjunction with analysis of delimited systems without compensating elements such as substitution from other producers and *downstream* (3.1.17) buffer storage. Battery limits need to be defined in each case.

Note 3 to entry: See Clause G.1 and Figure G.1 for further information.

Note 4 to entry: For offshore and onshore loading systems, some special *performance measures* (3.1.51) exist when undertaking loading performance analyses, see further details of such metrics in Clause I.18.

3.1.60
production efficiency
PE
ratio of production to *production potential* (3.1.64) over a specified period of time

Note 1 to entry: For PE calculation methods, see ISO/TS 3250.

Note 2 to entry: PE is normally considered as a historically reported measure, but can also be expressed as a forecast.

Note 3 to entry: With production is meant the actual production for historical reporting or forecast production for PE forecast. The actual production used for calculation of PE is not necessarily the fiscal metered production.

Note 4 to entry: Production efficiency is a term often used by operators for historic *production availability* (3.1.59) in the *life cycle phase* (3.1.31) "Operate" and is a reported measure, but in principle the same measure as predicted production availability that is a modelled measure.

Note 5 to entry: The operator will need to have a *production performance* (3.1.62) system to enable report and calculation of PE data. Such systems can be part of other organization business performance systems and can be related to CMMIS. See further information in ISO/TS 3250:2021, Annex A.

[SOURCE: ISO/TS 3250:2021, 3.1.39, modified — Note 1 to entry has been replaced.]

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3.1.61
production loss
difference between *production potential* (3.1.64) and actual production

Note 1 to entry: Production loss is caused by planned or unplanned activities or events. ISO/TS 3250:2021, Annex A defines the production loss categories that shall be used in the *upstream* (3.1.81) business category.

Note 2 to entry: The term production deferment is sometimes used to indicate that the oil or gas constituting the production loss is not totally lost but can be produced at a later stage. Production loss is the term used for PE calculation and reporting since the production loss is actually a loss within the time period considered.

Note 3 to entry: Examples of *lost revenue* (3.1.33) elements as a result of production loss are described in ISO 15663:2021, C.4.1.

Note 4 to entry: In early *life cycle phases* (3.1.31) prior to start-up of production when *production availability* (3.1.59) models are used for calculations (see Clause I.5), production loss can be estimated in relation to a defined reference production volume. See further information in Clauses G.2 and G.3.

[SOURCE: ISO/TS 3250:2021, 3.1.40, modified — Note 4 to entry has been added.]

3.1.62
production performance
capacity of a *system* (3.1.75) to meet demand for deliveries or performance

Note 1 to entry: *Production availability* (3.1.59), *deliverability* (3.1.12) or other appropriate measures can be used to express production performance.

Note 2 to entry: When using the term "production performance", it should be specified whether it is predicted or historic.

3.1.63
production performance analysis
systematic evaluations and calculations carried out to assess the *production performance* (3.1.62)

Note 1 to entry: Various *performance measures* (3.1.51) used in production performance analysis to address various parts of the hydrocarbon production chain are shown in Table G.1. Such production performance analysis applies volume-based performance measures but can be complemented by also time-based performance measures. *Production availability* (3.1.59) analysis is an analysis that normally covers the entire *asset* (3.1.2) (see Clause I.5); and the PAP covers such analysis. If only a part of the asset is covered, a production unavailability analysis can be performed. Annex D provides guidance for planning and reporting such analyses.

Note 2 to entry: Loading performance analysis is a particular type of production performance analysis focussing on offshore and onshore loading operations, which, for example, use metocean data to analyse weather impact on such operations (see Clauses I.17 and I.18).

3.1.64
production potential
maximum volume that can be produced through wells, plant and export installations, also considering market restrictions, within a given time period

Note 1 to entry: Production potential can vary over time.

Note 2 to entry: See more information regarding how to include production potential in ISO/TS 3250:2021 for use when calculating *production efficiency* (3.1.60). Note that ISO/TS 3250:2021 separates between "production potential" and the terms "well production potential" and "market potential".

[SOURCE: ISO/TS 3250:2021, 3.1.43, modified — The notes 2 to 4 to entry have been removed; a new note 2 to entry has been added.]

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3.1.65
redundancy
existence of more than one means for performing a *required function* (3.1.69) of an *item* (3.1.29)

Note 1 to entry: See ISO 14224:2016, C.1.2 for further details, where passive (cold), active (hot) standby and mixed redundancy are described.

Note 2 to entry: Redundancy in IEC 61508-1 is called "fault tolerance".

Note 3 to entry: IEC 60050-192:2015, 192-10-02 defines redundancy as “provision of more than one means for performing a function”.

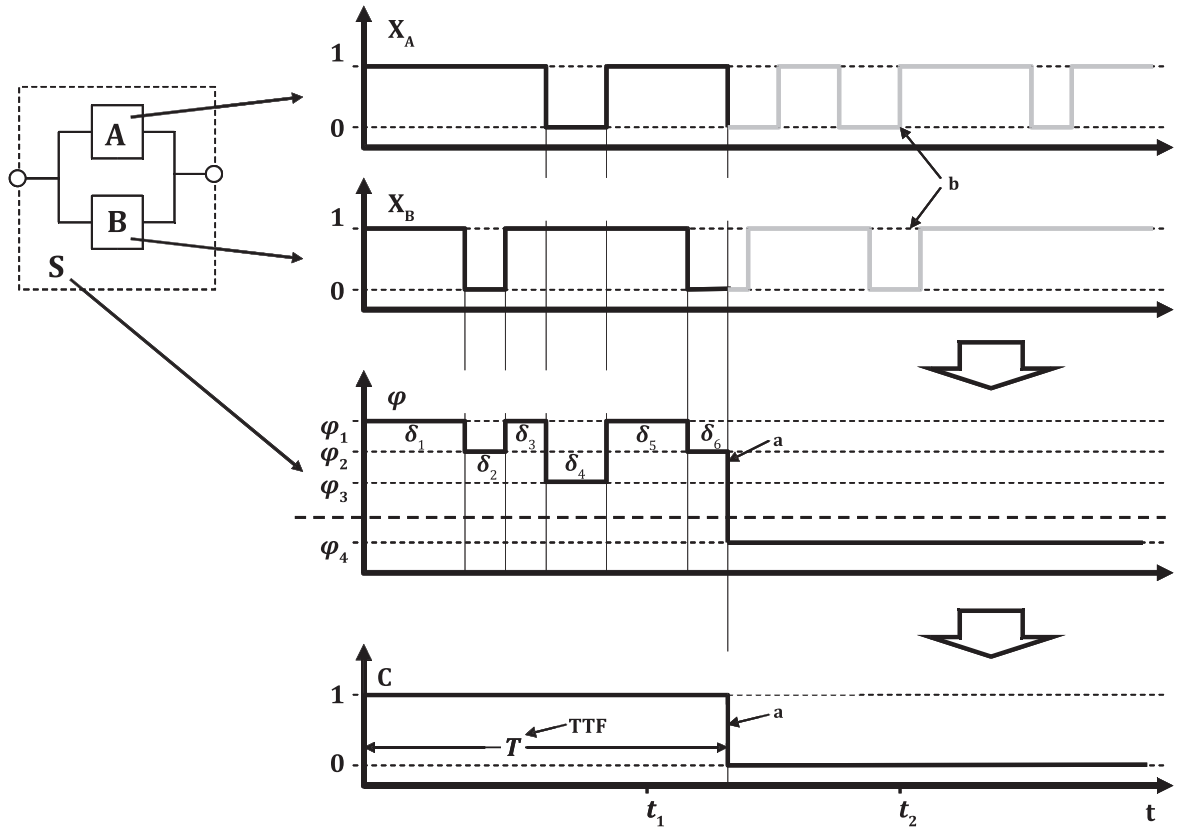
[SOURCE: ISO 14224:2016, 3.80]

3.1.66
reliability
ability of an *item* (3.1.29) to perform a *required function* (3.1.69) under given conditions for a given time interval

Note 1 to entry: The term "reliability" is also used as a measure of reliability performance and may also be expressed as *survival probability* (3.1.73).

Note 2 to entry: In Figure 3, the reliability is illustrated for a system S comprising two redundant components A and B. The system is reliable all over the interval $[0, t_1]$ but has had a *failure* (3.1.18) during $[0, t_2]$.

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Key

A	component A
B	component B
S	system
TTF	time to failure
δ	period of time
X_A	state of component A (binary item)
X_B	state of component B (binary item)
φ	state of system S (multi-state item)
C	class of states of system S (binary item)
t	time
a	Failure of system S.
b	State does not matter after the failure of system S.

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

Figure 3 — Illustration of a system S comprising two redundant components A and B

[SOURCE: ISO 14224:2016, 3.81, modified — Note 1 to entry has been adjusted, notes 2 to 4 to entry have been removed; new note 2 to entry and Figure 3 have been added.]

3.1.67
reliability data
data for *reliability* (3.1.66), *maintainability* (3.1.34) and maintenance support performance

[SOURCE: ISO 14224:2016, 3.82]

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3.1.68
reliability management
activities undertaken to achieve *reliability* (3.1.66) related *performance objectives* (3.1.52) and *performance requirements* (3.1.53)

Note 1 to entry: Reliability management reflects *production assurance* (3.1.58) activities on equipment and system level. In project or product development and design phases this is often called "reliability engineering".

Note 2 to entry: A reliability management programme (RMP) can be used to describe such activities, see Clause A.1.

3.1.69
required function
function or combination of functions of an *item* (3.1.29) that is considered necessary to provide a given service

[SOURCE: ISO 14224:2016, 3.83]

3.1.70
risk
combination of the probability of an event and the consequences of the event

Note 1 to entry: This definition is based on ISO/IEC Guide 51:2014, 3.9 that defines risk as combination of the probability of occurrence of harm and the severity of that harm, where the probability of occurrence includes the exposure to a hazardous situation, the occurrence of a hazardous event and the possibility to avoid or limit the harm. "Harm" has been replaced by "event" in the definition to cope with *production assurance* (3.1.58) purpose. It is also similar to the definition of the "level of risk" given in ISO 31073:2022, 3.3.22 (i.e. “combination of consequences and their likelihood”).

Note 2 to entry: Events leading to *production losses* (3.1.61) are considered within the production assurance field.

3.1.71
risk register
record of information about identified *risks* (3.1.70)

Note 1 to entry: Project risk management requires managing identified risks as described in ISO 31000 and ISO 29001. The term is used in this document regarding process 7, see Clause C.2.

3.1.72
state capacity
processing ability of an item state

Note 1 to entry: The capacity of an item state is related to the amount of production the item can produce or process in this state. For example, in Figure 2, component A has a capacity of 200 bpd.

EXAMPLE 1 A single oil production well with two states [*binary item* (3.1.6)] has, for example, a capacity of 100 bpd when it is in *up state* (3.1.79) and of 0 bpd when it is in *down state* (3.1.15) (see component B in Figure 2).

EXAMPLE 2 An oil production system made up of two wells, A and B, producing respectively 200 bpd and 100 bpd, has four states. This is illustrated in Figure 2:

— φ_1 (A and B producing) : capacity = 300 bpd;

— φ_2 (A producing alone) : capacity = 200 bpd;

— φ_3 (B producing alone) : capacity = 100 bpd;

— φ_4 (A and B failed) : capacity = 0 bpd.

When the reference value is non-ambiguous, the capacity can be given in percentage. For example, with regard to the maximum capacity of the producing system, the capacity of φ_1 is 100 %, the capacity of φ_2 is 66,6 %, the capacity of φ_3 is 33,3 % and the capacity of φ_4 is 0 %.

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3.1.73
survival probability
$R(t)$
likelihood of the continued functioning of an *item* (3.1.29)

Note 1 to entry: This likelihood is calculated by using Formula (1):

$$R(t) = P(T > t) \quad (1)$$

where $P(T > t)$ is the probability that the time to *failure* (3.1.18) of an item, T, is greater than t, a time equal to or greater than 0.

Note 2 to entry: Reliability is illustrated in Figure 3 for a system S comprising two redundant components A and B. As $T > t_1$ the system is reliable all over the interval $[0, t_1]$ and is surviving at time t_1. As $T < t_2$ the system is not surviving at time t_2.

3.1.74
sustainability
state of the global system, including environmental, social and economic aspects, in which the needs of the present are met without compromising the ability of future generations to meet their own needs

Note 1 to entry: The environmental, social and economic aspects interact, are interdependent and are often referred to as the three dimensions of sustainability.

Note 2 to entry: Sustainability is the goal of sustainable development.

Note 3 to entry: Sustainability aspects of maintenance cover but are not limited to unnecessary maintenance, rest useful lifetime, maintenance efficiency and (re)use of materials.

[SOURCE: ISO Guide 82:2019, 3.1, modified — Note 3 to entry has been added.]

3.1.75
system
combination of interacting parts that collectively has one or more purposes

Note 1 to entry: See a taxonomic structure of systems in ISO 14224: 2016, Table A.3 for various business categories.

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

3.1.76
technical availability
availability (3.1.3) provided by the design under ideal conditions of operation and *maintenance* (3.1.36)

Note 1 to entry: Delays associated with maintenance, such as logistic and administrative delays are excluded. This *down time* (3.1.16) represents *maintainability* (3.1.34); see Figure G.1.

Note 2 to entry: Only the *active repair time* (3.1.1) of unplanned down time [i.e. the mean active repair time (MART; see ISO 14224:2016, 3.59) and no mobilization time for the *corrective maintenance* (3.1.11)] is included in the technical availability calculations. The active repair time of critical *failures* (3.1.18) detected during a periodic test is reflected by the "technical availability", but not the equipment down time whilst the periodic test is performed.

Note 3 to entry: For estimation of technical availability, see ISO 14224:2016, C.2.3. For benchmarking, the technical availability is KPI 8 in ISO 14224:2016, Table E.3.

[SOURCE: IEC 60050-192:2015, 192-08-02, modified — The preferred term "technical availability" has been added and the terms “inherent availability” and “intrinsic availability” have been removed; note 1 to entry has been adjusted; and notes 2 and 3 to entry have been added.]

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3.1.77
technology qualification
process of providing evidence that the technology performs as required for the specified application area

Note 1 to entry: The requirements include both functional (technical and operational) and associated reliability requirements for its *design life* (3.1.13). Application area refers to the operating conditions, environment or purpose for which the technology is to be used.

Note 2 to entry: See further information in Clauses C.3 and I.12.

3.1.78
uncertainty
inability to determine accurately what is or will be the true value of a quantity

Note 1 to entry: Uncertainty can have different meanings. It can be used as a measure of *variability* (3.1.82) within a population, which is a type of uncertainty often referred to as stochastic (or aleatory) uncertainty. Uncertainty can also have a subjective meaning (epistemic uncertainties).

Note 2 to entry: Uncertainty of input data can be relevant for availability calculations as described in this document.

Note 3 to entry: According to ISO 31000, uncertainty is the state, even partial, of deficiency of information related to, understanding or knowledge of, an event, its consequences, or likelihood.

[SOURCE: ISO 14224:2016, 3.95, modified — In note 1 to entry, the phrase "within reliability data collection and exchange" has been removed from the end of the first sentence; notes 2 and 3 to entry have been added.]

3.1.79
up state
state of being able to perform as required

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

Note 2 to entry: Up state relates to the availability performance of the item.

Note 3 to entry: See also ISO/TR 12489:2013, Figure 5.

EXAMPLE In Figure 1, the up state class of the system S comprises three states $\{\varphi_1, \varphi_2, \varphi_3\}$ and the system is in up state at time t_1.

[SOURCE: IEC 60050-192:2015, 192-02-01, modified — Notes to entry have been replaced by the new notes 1 to 3 to entry; EXAMPLE has been added.]

3.1.80
up time
time interval during which an *item* (3.1.29) is in an *up state* (3.1.79)

Note 1 to entry: See also ISO/TR 12489:2013, Figure 3.

Note 2 to entry: Mean up time is defined in IEC 60050-192:2015 as “expectation of the up time”.

[SOURCE: ISO 14224:2016, 3.97]

3.1.81
upstream
business category of the petroleum industry involving exploration and production

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

[SOURCE: ISO 14224:2016, 3.98, modified — EXAMPLE has been removed.]

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3.1.82
variability
variations in *performance measures* (3.1.51) for different time periods under defined framework conditions

Note 1 to entry: The variations can be a result of the *down time* (3.1.16) pattern for equipment and systems or operating factors, such as wind, waves and access to certain repair resources.

3.2 Abbreviated terms

BBN	Bayesian belief network
BOP	blowout preventer
bpd	barrels per day
CAPEX	capital expenditure
CCS	carbon capture and storage
CMMIS	computerized maintenance management information system
ESD	emergency shut down
FEED	front-end engineering and design
FID	final investment decision
FMEA	failure modes and effects analysis
FMECA	failure modes, effects and criticality analysis
FN	flow network
FTA	fault tree analysis
GHG	greenhouse gas
HAZOP	hazard and operability (study)
HSE	health, safety and environment
KPI	key performance indicator
LCC	life cycle cost
LCCMP	life cycle costing management plan
LOSTREV	lost revenue
MPA	Markov process analysis
NPV	net present value
OPEX	operating expenditure
PAP	production assurance programme
PE	production efficiency
PN	Petri nets
POR	performance and operability review

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