



BSI Standards Publication

Petroleum, petrochemical and natural gas industries — Calculation and reporting production efficiency in the operating phase

National foreword

This Published Document is the UK implementation of CEN ISO/TS 3250:2022. It is identical to ISO/TS 3250:2021. It supersedes PD ISO/TS 3250:2021, which is withdrawn.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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English Version

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

Industries du pétrole, de la pétrochimie et du gaz
naturel - Calcul et rapport d'efficacité de la production
dans la phase d'exploitation (ISO/TS 3250:2021)

Erdöl-, petrochemische und Erdgasindustrie -
Berechnung und Meldung der Produktionseffizienz in
der Betriebsphase (ISO/TS 3250:2021)

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European foreword

The text of ISO/TS 3250:2021 has been prepared by Technical Committee ISO/TC 67 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" of the International Organization for Standardization (ISO) and has been taken over as CEN ISO/TS 3250:2022 by Technical Committee CEN/TC 12 "Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries" the secretariat of which is held by NEN.

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Endorsement notice

The text of ISO/TS 3250:2021 has been approved by CEN as CEN ISO/TS 3250:2022 without any modification.

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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, *Materials, equipment and offshore structures for petroleum, petrochemical and natural gas industries*.

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 petroleum, petrochemical and natural gas industries involve large capital expenditure as well as operating expenditure. Revenue loss caused by production loss will affect the profitability of such industry and for a specific plant operatorship.

Production efficiency (PE) is a term often used by operators for historic production availability in the operating phase. PE is a reported measure, and it can be compared with the predicted (or targeted) production availability made during a project development stage. Furthermore, PE is forecasted and tracked during the operating phase to allow tracking of performance. ISO 20815:2018 addresses production assurance activities including analytical methods for predicting production availability, and also includes a production loss categorization.

This document supports this production loss categorization with a harmonized approach for calculating and reporting production loss and production efficiency in the operating phase, including forecasting during this life cycle phase. This will enable precise and consistent feedback of production performance for use in production and operational planning to achieve optimal PE for the operators and associated industry stakeholders. Focus is given to actual produced volume and reference production volume, e.g. production potential that will depend on reservoir and well constraints, plant/process constraints, export/transportation constraints and market constraints. Standardization of PE reporting across the industry will drive consistency and provide better quality PE information and communication for operators and partners.

Petroleum, petrochemical and natural gas industries — Calculation and reporting production efficiency in the operating phase

1 Scope

This document provides requirements and guidance for reporting of production performance data and production loss data in the operating phase by use of production loss categorization. It supplements the principles of ISO 20815:2018, Clause E.3 and Annex G by providing additional details.

This document focusses on installations and asset elements within the upstream business category. Business categories and associated installations and plants/units, systems and equipment classes are used in line with ISO 14224:2016, Annex A.

The production loss categories given in [Annex A](#) are given at a high taxonomic level and supplements the reporting of failure and maintenance parameters as defined in ISO 14224:2016, Annex B.

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 20815:2018, *Petroleum, petrochemical and natural gas industries — Production assurance and reliability management*

3 Terms, definitions and abbreviated terms

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

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

- ISO Online browsing platform: available at <https://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 Terms and definitions

3.1.1

achieved production potential

production potential ([3.1.43](#)) that in retrospect can be verified as the maximum achievable production in a given time period

Note 1 to entry: Achieved production potential is the sum of the achieved production and the estimated *production loss* ([3.1.40](#)) occurring in the four production potential elements: *well production potential* ([3.1.58](#)), *plant production capacity* ([3.1.34](#)), *export capacity* ([3.1.12](#)) and *market potential* ([3.1.26](#)).

Note 2 to entry: Achieved production potential can vary over time.

3.1.2

asset

item ([3.1.21](#)), thing or entity that has potential or actual value to an organization

Note 1 to entry: Physical assets usually refer to equipment, inventory and properties owned by the organization. Physical assets are the opposite of intangible assets, which are non-physical assets such as leases, brands, digital assets, licenses, intellectual property rights, reputation or agreements.

Note 2 to entry: A grouping of assets referred to as an asset system (see ISO 55000:2014, 3.2.5) could 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 plant/units, *systems* ([3.1.50](#)), *equipment classes* ([3.1.11](#)), subunits, components, etc. as described in ISO 14224:2016, Table 2. In this document, *asset element* ([3.1.3](#)) is used to group these as shown in [Table A.2](#).

[SOURCE: ISO 55000:2014, 3.2.1, modified — Notes 2 and 3 to entry have become Notes 1 and 2 to entry, respectively, new Note 3 to entry has been added.]

3.1.3

asset element

underlying *item* ([3.1.21](#)) for the *asset* ([3.1.2](#)) that is needed for the asset to deliver its product

Note 1 to entry: In this document, which is applicable for upstream business category, the asset elements are wells (including reservoir), subsea installations, production facilities (including process and utilities), and export and import facilities as shown in [Table A.2](#). For other business categories, the asset elements will be different.

Note 2 to entry: The underlying items of the individual asset element will be *systems* ([3.1.50](#)) and relevant *equipment classes* ([3.1.11](#)) as defined in ISO 14224:2016, and as shown in [Table D.1](#).

3.1.4

availability

ability to be in a state to perform as required

Note 1 to entry: Various availability terms are defined in ISO 14224:2016, ISO 20815:2018 and ISO/TR 12489:2013.

[SOURCE: IEC 60050-192:2015, 192-01-23, modified — Note 1 to entry has been modified, Note 2 to entry has been deleted.]

3.1.5

conventional resources

oil and gas resources where the reservoir rock characteristics and fluid trapping mechanisms permit reservoir fluids to readily flow into the wellbore

Note 1 to entry: This usually includes conventional, reasonably permeable and connected, sandstone and carbonate reservoirs.

3.1.6

corrective maintenance

maintenance ([3.1.24](#)) carried out after fault detection to effect restoration

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

3.1.7

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 buffer storage, is included

Note 1 to entry: See [Figure B.1](#) for further information.

[SOURCE: ISO 20815:2018, 3.1.8]

3.1.8**down time**

time interval during which an *item* ([3.1.21](#)) is in a down state

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 Figure 4 and Table 4 in ISO 14224:2016) or production down time (see Figures I.1 and I.2 in ISO 20815:2018). Down time for other operations such as drilling is not addressed in this document but can affect production or prolong the production down time. It is important to distinguish between the equipment down time itself and the down time of the plant to which the equipment belongs; this document focusses on down time of the latter.

[SOURCE: IEC 60050-192:2015, 192-02-21, modified — New Notes 1 and 2 to entry have been added, figure has been deleted.]

3.1.9**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.

Note 2 to entry: The term 'downstream' is sometimes used in this document to reflect installations to which products from installations within upstream business category are transported whereas these installations do not necessarily belong to the downstream business category.

[SOURCE: ISO 14224:2016, 3.17, modified — Note 2 to entry has been added.]

3.1.10**enhanced oil recovery****EOR**

reservoir process involving the injection of materials not normally present in the reservoir to enhance the overall oil recovery from such reservoir

Note 1 to entry: Also denoted tertiary oil recovery processes; includes chemical, thermal and gas miscible processes, among others.

3.1.11**equipment class**

class of similar type of equipment units (e.g. all pumps)

Note 1 to entry: See ISO 14224:2016, Annex A for equipment specific data.

[SOURCE: ISO 14224:2016, 3.18]

3.1.12**export capacity**

maximum volume rate that can be exported

Note 1 to entry: The export capacity can be limited by oil or gas or any other product (e.g. produced water and CO₂). Both the capacity of the export systems (e.g. pipeline) and the downstream receiving facilities needs to be considered.

Note 2 to entry: The export capacity is a volume rate applicable for the product exported. Restrictions in the flowrate to storage caused by limitations in the capacity of export pumps, pipeline capacity, etc., will affect export capacity. Limited storage volume resulting in reduced or no production due to insufficient offtake capacity (e.g. shuttle tanker delay) is an event and will not affect the export capacity but it is a *production loss* ([3.1.40](#)).

Note 3 to entry: The plant export capacity can vary over time.

3.1.13

failure

loss of ability to perform as required

Note 1 to entry: A failure of an *item* ([3.1.21](#)) is an event that results in a fault (i.e. a state) of that item. This is illustrated in the figure in ISO 20815:2018, 3.1.50 for a binary system S comprising two redundant components A and B.

[SOURCE: IEC 60050-192:2015, 192-03-01, modified — Note 1 to entry has been modified, Notes 2 and 3 to entry have been deleted.]

3.1.14

failure data

data characterizing the occurrence of a failure event

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

[SOURCE: ISO 14224:2016, 3.25]

3.1.15

failure impact

effect of a *failure* ([3.1.13](#)) on an equipment's function(s) or on the plant

Note 1 to entry: On the equipment level, failure impact can be classified in three classes (critical, degraded, incipient); see definitions of 'critical failure' (ISO 14224:2016, 3.9), 'degraded failure' (ISO 14224:2016, 3.11) and 'incipient failure' (ISO 14224:2016, 3.40). Classification of failure impact on taxonomy levels 3 to 5 (see ISO 14224:2016, Figure 3) is shown in ISO 14224:2016, Table 3.

Note 2 to entry: Classification of failure impact on taxonomy levels 4 and 5 (see ISO 14224:2016, Figure 3) is shown in ISO 14224:2016, Table 3. See also ISO 14224:2016, C.1.10.

[SOURCE: ISO 14224:2016, 3.28]

3.1.16

human error

discrepancy between the human action taken or omitted and that intended

Note 1 to entry: See further information in ISO 14224:2016, 3.36.

[SOURCE: IEC 60050-192:2015, 192-03-14, modified — "or required" has been deleted from the definition, example has been deleted, Note 1 to entry has been added.]

3.1.17

improved oil recovery

IOR

process used to improve the overall oil recovery from a reservoir, including but not limited to *enhanced oil recovery* ([3.1.10](#))

Note 1 to entry: IOR includes not only reservoir recovery processes (secondary and tertiary), but also other techniques such as infill drilling and artificial lift.

Note 2 to entry: Secondary recovery processes refer to processes involving the injection of gas and/or water, mostly for maintaining reservoir pressure.

3.1.18

injection efficiency

IE

I_E

ratio of injected volume to the *injection potential* ([3.1.19](#)) over a specified period of time

Note 1 to entry: This is a volume-based performance measure similar to *production efficiency* ([3.1.39](#)).

Note 2 to entry: Injection availability is a time-based measure.

3.1.19 injection potential

V_{IP}

maximum volume that can be injected in a reservoir within a given time period, considering the capacity of injection systems and injection wells

Note 1 to entry: Injection potential can be related to injection of gas, water, CO₂ or other products.

Note 2 to entry: The maximum volume that can be injected may be taken to mean the 'optimum' volume that is injected to achieve optimal reservoir management. The optimum volume is often the one that maximizes economic recovery from the field. This optimum volume can be less than the maximum volume defined by the physical system capacity of the injection system, wells or reservoir.

3.1.20 integrity

ability of a barrier to function as required when needed

Note 1 to entry: See ISO/TR 12489:2013, 3.1.2 for definition of safety integrity.

Note 2 to entry: There are different definitions of integrity: plant, *asset* (3.1.2), *system* (3.1.50), pipeline (see DNVGL-ST-F101:2017), well (see ISO 16530-1:2017, 3.73), mechanical, safety (see ISO/TR 12489:2013, 3.1.2), structural (see ISO 19900:2019, 3.50) and technical.

[SOURCE: ISO 20815:2018, 3.1.22]

3.1.21 item

subject being considered

Note 1 to entry: The item can be an individual part, component, device, functional unit, equipment, subsystem, or *system* (3.1.50).

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/unit and installation. See also ISO 14224:2016, Figure 3.

[SOURCE: IEC 60050-192:2015, 192-01-01, modified — Notes 3, 4 and 5 to entry have been deleted, new Note 3 to entry has been added.]

3.1.22 life cycle phase

discrete stage in the life cycle with a specified purpose

Note 1 to entry: The different life cycle phases 'Explore', 'Appraise', 'Select', 'Define', 'Execute', 'Operate' and 'Abandon' are further described in ISO 15663:2021, 4.5.

Note 2 to entry: This document focusses on the life cycle phase 'Operate' and uses the term 'operating phase' in this respect.

[SOURCE: ISO 15663:2021, 3.1.28, modified — Note 2 to entry has been added.]

3.1.23 lost revenue

total cost of lost or deferred production due to *down time* (3.1.8)

Note 1 to entry: See further information regarding estimation of lost revenue in ISO 15663:2021, Clause C.4, and a more general definition of lost revenue is given in ISO 15663:2021, 3.1.29.

[SOURCE: ISO 20815:2018, 3.1.25, modified — Note 1 to entry has been added.]

3.1.24

maintenance

combination of all technical and management actions intended to retain an *item* ([3.1.21](#)) 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 deleted.]

3.1.25

maintenance impact

effect of the *maintenance* ([3.1.24](#)) on the plant or equipment's function(s)

Note 1 to entry: On the equipment level, two classes of impact are defined: critical and non-critical. On plant level, three classes are defined: total, partial or zero impact.

Note 2 to entry: For the calculation of PE data, it can be beneficial to separate the *production loss* ([3.1.40](#)) arising from the failure event and from the maintenance impact on production, into two different production loss categories. See further guidance in [A.3.2](#).

[SOURCE: ISO 14224:2016, 3.52, modified — Note 2 to entry has been added.]

3.1.26

market potential

maximum volume rate that can be received by the market

Note 1 to entry: A sales contract can limit the market potential.

Note 2 to entry: The market potential can vary over time.

Note 3 to entry: The market potential reflects market constraints when determining the *structural maximum production potential* ([3.1.49](#)). When determining the *structural maximum injection potential* ([3.1.48](#)) market potential means the maximum volume that can be delivered by the market.

3.1.27

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 deleted.]

3.1.28

modification

combination of all technical and administrative actions intended to change an *item* ([3.1.21](#))

Note 1 to entry: Modification is not normally part of *maintenance* ([3.1.24](#)) but is frequently performed by maintenance personnel. This is typically the maintenance activity 'Modify' as defined in ISO 14224:2016, Table B.5.

Note 2 to entry: In this document, the use of the term modification is primarily meant to cover major modification activities. See further details in 8.2.2 with respect to how such major modifications are reflected in PE reporting.

[SOURCE: ISO 14224:2016, 3.67, modified — Notes 2 and 3 to entry have been deleted, new Note 2 to entry has been added.]

3.1.29

operative well

well that it is economically warrantable to operate

Note 1 to entry: The individual well potential is part of the *well production potential* ([3.1.58](#)) even if the well is temporarily shut down due to equipment failure, well intervention, valve testing, reservoir monitoring, etc. See also [Table 4](#).

Note 2 to entry: Economic warrantability will be defined by the operator. Various economic subject matters will determine this economic margin, e.g. CAPEX, OPEX and revenue factors.

3.1.30

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 ISO 20815:2018, Annex F.

[SOURCE: ISO 20815:2018, 3.1.41]

3.1.31

performance requirement

required minimum level for the performance of the *system* ([3.1.50](#))

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

[SOURCE: ISO 20815:2018, 3.1.42, modified — Note 1 to entry has been modified.]

3.1.32

petrochemical

business category producing the 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 deleted.]

3.1.33

planned event

event that is intentional, the start and end time is determined, and the effect of the event in terms of consequences is predictable

Note 1 to entry: See further information in [8.2](#).

Note 2 to entry: See production loss categories associated with planned events in [Table A.1](#).

3.1.34

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 (see [7.3](#)). 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* ([3.1.50](#)) between the elements well and export as illustrated in [Figure 5](#).

3.1.35

preventive maintenance

maintenance ([3.1.24](#)) carried out to mitigate degradation and reduce the probability of *failure* ([3.1.13](#))

Note 1 to entry: See also condition-based maintenance and planned (scheduled) maintenance.

Note 2 to entry: Preventive maintenance can be categorized as shown in ISO 14224:2016, Figure 6.

[SOURCE: IEC 60050-192:2015, 192-06-05 — Note 2 to entry has been added]

3.1.36

primary product

hydrocarbon product that is the main contributor to the production target from an *asset* (3.1.2)

Note 1 to entry: The primary product can be crude oil, condensate or gas. The primary product from an asset (e.g. an individual upstream field or field infrastructure consisting of various installations) will be a result of reservoir characteristics, field development planning and facility design as determined by the production strategy of the field or installation in question.

Note 2 to entry: The primary product can change throughout the operating phase of the asset.

3.1.37

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 activities relate closely to the integrity management of the installations. See definition of *integrity* (3.1.20).

Note 2 to entry: See further information in ISO 20815:2018 with respect to *production assurance* (3.1.37) for a variety of oil and gas activities.

[SOURCE: ISO 20815:2018, 3.1.45, modified — Note 2 to entry has become Note 1 to entry, new Note 2 to entry has been added.]

3.1.38

production availability

P_A

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

Note 1 to entry: This measure is used in conjunction with analysis of delimited systems without compensating elements such as substitution from other producers and downstream buffer storage. Battery limits need to be defined in each case.

Note 2 to entry: See ISO 20815:2018, Clause G.1 and Figure G.1 for further information.

[SOURCE: ISO 20815:2018, 3.1.46, modified — Notes 1, 3, 4 and 5 to entry have been deleted, Note 2 to entry has become Note 1 to entry, new Note 2 to entry has been added.]

3.1.39

production efficiency

PE

P_E

ratio of production to *production potential* (3.1.43) over a specified period of time

Note 1 to entry: PE calculation methodology is described in 5.4.1. There are two methods for PE calculations as described in 7.2 to 7.4.

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, see also 6.3.

Note 4 to entry: *Production efficiency* (3.1.39) is a term often used by operators for historic *production availability* (3.1.38) in the operating phase and is a reported measure, but in principle the same measure as predicted production availability that is a modelled measure. See also 3.1.38.

Note 5 to entry: The operator will need to have a production performance 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 Annex A.

3.1.40**production loss**

difference between *production potential* (3.1.43) and actual production

Note 1 to entry: Production loss is caused by planned or unplanned activities or events. [Annex A](#) defines production the loss categories that shall be used in the upstream business category.

Note 2 to entry: The term production deferment is sometimes used to indicate that the oil/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 elements as a result of production loss are described in ISO 15663:2021, C.4.1.

3.1.41**production performance**

capacity of a *system* (3.1.50) to meet demand for deliveries or performance

Note 1 to entry: *Production availability* (3.1.38), *deliverability* (3.1.7) or other appropriate measures can be used to express production performance.

Note 2 to entry: The use of production performance terms should specify whether it represents a predicted or historic production performance.

Note 3 to entry: In this document, *production efficiency* (3.1.39) is used as the measure for production performance.

[SOURCE: ISO 20815:2018, 3.1.47, modified — Note 3 to entry has been added.]

3.1.42**production performance analysis**

systematic evaluations and calculations carried out to assess the *production performance* (3.1.41)

Note 1 to entry: Various measures used in production performance analysis to address various parts of the hydrocarbon production chain are shown in [Annex B](#). Production availability analysis is an analysis that normally covers the entire *asset* (3.1.2); see ISO 20815:2018, Clause I.5.

[SOURCE: ISO 20815:2018, 3.1.48, modified — 'of a system' has been removed from the definition, Notes 1 and 2 to entry have been deleted, new Note 1 to entry has been added.]

3.1.43**production potential**

V_{pp}

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: Production potential can be expressed as *structural maximum production potential* (3.1.49) or *achieved production potential* (3.1.1).

Note 3 to entry: Production potential is the maximum production potential that is technically feasible and economically acceptable and is the minimum of the four production potential elements: *well production potential* (3.1.58), *plant production capacity* (3.1.34), *export capacity* (3.1.12) and *market potential* (3.1.26). See also [Figure 5](#).

Note 4 to entry: For business categories *midstream* (3.1.27), *downstream* (3.1.9) and *petrochemical* (3.1.32) where there is not a continuous flow from the reservoir to the plant, reservoir and wells might not be relevant for the production potential. However, limitations on import capacity are still to be considered when determining the production potential.

Note 5 to entry: In this document, *production efficiency* (3.1.39) is calculated using 'production potential' instead of the more general 'reference production volume'. See [Clause B.2](#).

3.1.44

reliability

ability of an *item* ([3.1.21](#)) to perform a required function under given conditions for a given time interval

[SOURCE: ISO 14224:2016, 3.81 modified — Notes to entry have been deleted.]

3.1.45

reliability management

activities undertaken to achieve reliability related *performance objectives* ([3.1.30](#)) and *performance requirements* ([3.1.31](#))

[SOURCE: ISO 20815:2018, 3.1.52 modified — Notes to entry have been deleted.]

3.1.46

safety critical equipment

equipment and *items* ([3.1.21](#)) of permanent, temporary and portable equipment playing an important role in safety systems/functions

[SOURCE: ISO 14224:2016, 3.84]

3.1.47

secondary product

hydrocarbon product that is produced from an *asset* ([3.1.2](#)) as a result of processing a *primary product* ([3.1.36](#))

Note 1 to entry: The secondary product can be crude oil, condensate or gas. The secondary product from an asset (e.g. an individual upstream field or field infrastructure consisting of various installations) will be a result of reservoir characteristics, field development planning and facility design.

Note 2 to entry: The secondary product can change throughout field life and can become the primary product, depending on the field characteristics.

3.1.48

structural maximum injection potential

SMIP

estimate of the *injection potential* ([3.1.19](#))

Note 1 to entry: SMIP is the maximum injection potential that is technically feasible and economically acceptable, and it is the minimum of the four injection potential elements: well injection potential, plant injection capacity, import capacity and *market potential* ([3.1.26](#)). See also [Figure 6](#).

Note 2 to entry: SMIP can vary over time.

Note 3 to entry: SMIP can be adjusted retrospectively when calculating and reporting *injection efficiency* ([3.1.18](#)).

3.1.49

structural maximum production potential

SMPP

estimate of the *production potential* ([3.1.43](#))

Note 1 to entry: SMPP is the maximum production potential that is technically feasible and economically acceptable, and it is the minimum of the four production potential elements: *well production potential* ([3.1.58](#)), *plant production capacity* ([3.1.34](#)), *export capacity* ([3.1.12](#)) and *market potential* ([3.1.26](#)). See also [Figure 5](#).

Note 2 to entry: SMPP can vary over time.

Note 3 to entry: SMPP can be adjusted retrospectively when calculating and reporting *production efficiency* ([3.1.39](#)).

3.1.50**system**

set of interrelated *items* (3.1.21) that collectively fulfil a requirement

Note 1 to entry: The hierarchical system structure that applies in this document for the purpose of reporting *production loss* (3.1.40) uses the taxonomic structure in ISO 14224: 2016, Table A.3 for the upstream business category. This table does also include systems and *equipment classes* (3.1.11) applicable for all business categories for 'Safety and control systems', 'Utilities' and 'Auxiliaries' as further described in Table D.1.

[SOURCE: IEC 60050-192:2015, 192-01-03, modified — Notes to entry have been deleted, new Note 1 to entry has been added.]

3.1.51**trip**

shutdown of machinery from normal operating condition to full stop

Note 1 to entry: Trip: The shutdown is activated automatically by the control/monitoring system:

- real trip The shutdown is effectuated as a result of a monitored (or calculated) value in the control system exceeding a pre-set limit;
- spurious trip Unexpected shutdown resulting from *failure(s)* (3.1.13) in the control monitoring system or error(s) imposed on the control/monitoring system originating from the environment or people.

Note 2 to entry: See also ISO/TR 12489:2013, 3.4.14.

[SOURCE: ISO 14224:2016, 3.93]

3.1.52**turnaround**

revision shutdown

planned event (3.1.33) wherein an entire process unit is taken off stream for revamp or renewal

Note 1 to entry: See also ISO 20815:2018, Table G.1.

[SOURCE: ISO 14224:2016, 3.94]

3.1.53**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* (3.1.53) 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 the production efficiency calculations as described in this document.

Note 3 to entry: 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 — Note 1 to entry has been modified, Notes 2 and 3 to entry have been added.]

3.1.54**unconventional resources**

oil and gas resources where the reservoir rock characteristics and fluid trapping mechanisms do not meet the criteria for *conventional resources* (3.1.5)

Note 1 to entry: This includes, but is not limited to, shale oil and gas reservoirs that are commonly produced through multi-fractured horizontal wells.

Note 2 to entry: Coalbed methane (or coal seam gas), 'tight' (low permeability) and/or poorly connected sandstones and carbonate reservoirs may also be considered unconventional resources.

3.1.55

unplanned event

event that is unanticipated, unintentional or uncontrolled

Note 1 to entry: See further information in [8.2](#).

Note 2 to entry: See production loss categories associated with unplanned events in [Table A.1](#).

Note 3 to entry: Risk management (see ISO 31000:2018) and production assurance activities (see ISO 20815:2018) can have identified such unplanned event and thereby contingency exists to handle this situation.

3.1.56

upstream

business category of the petroleum industry involving exploration and production

EXAMPLE Offshore oil/gas production facility, drilling rig, intervention vessel.

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

[SOURCE: ISO 14224:2016, 3.98]

3.1.57

variability

variations in performance measures for different time periods under defined framework conditions

[SOURCE: ISO 20815:2018, 3.1.62, modified — Note 1 to entry has been deleted.]

3.1.58

well production potential

maximum production rate from the wells

Note 1 to entry: The well production potential is the combined production from individual wells at optimum reservoir conditions. The individual well potential is determined by the reservoir pressure and productivity but can be limited by well design capacity. The well production potential can be limited by flowline capacity, actual process conditions (e.g. inlet separator pressure), etc.

Note 2 to entry: The well production potential is based on measured oil and gas flow rates corrected to export conditions.

Note 3 to entry: The well production potential can vary over time.

Note 4 to entry: The well production potential is not affected if the well is temporarily shut down due to planned and unplanned activities, such as preventive or *corrective maintenance* ([3.1.6](#)). See also [Table 4](#).

3.2 Abbreviations

boe	barrel of oil equivalent
CHP	combined heat and power
CMMIS	computerised maintenance management information system
DHSV	downhole safety valve
E&P	exploration and production
EDP	emergency depressurization
ESD	emergency shutdown
FLNG	floating LNG

FPSO	floating production, storage and offloading
FSU	floating storage unit
GHG	greenhouse gas
GTL	gas to liquids
HSE	health safety and environment
KPI	key performance indicator
LNG	liquefied natural gas
LPG	liquefied petroleum gas
MART	mean active repair time
MTTRes	mean time to restoration
NGL	natural gas liquids
OPEX	operating expenditure
P&A	plug & abandon
PSD	process shutdown
QA	quality assurance
Sm ³ oe	standard m ³ of oil equivalent
SPAR	single point anchor reservoir
SPS	subsea production system
SSIV	subsea isolation valve
SURF	subsea, umbilical, riser and flowline
TLP	tension leg platform
toe	ton of oil equivalent

4 Application

4.1 Users of this document

This document is intended for the following users:

- **Operators/owners:** These organizations are the primary users of this document and can use it to calculate and report production loss, and/or analyse related data, and/or recommend actions to improve PE. They can also use it to report and communicate PE data within their organizations, or to other organizations in a partnership or joint venture.
- **Contractors:** These organizations can use this document for similar purposes to that of operators/owners for those activities in the operating phase (e.g. maintenance, modifications and operation support) for which they are responsible.
- **Vendors/manufacturers/suppliers:** These organizations can use this document to support and advise clients/operators on PE improvement efforts.

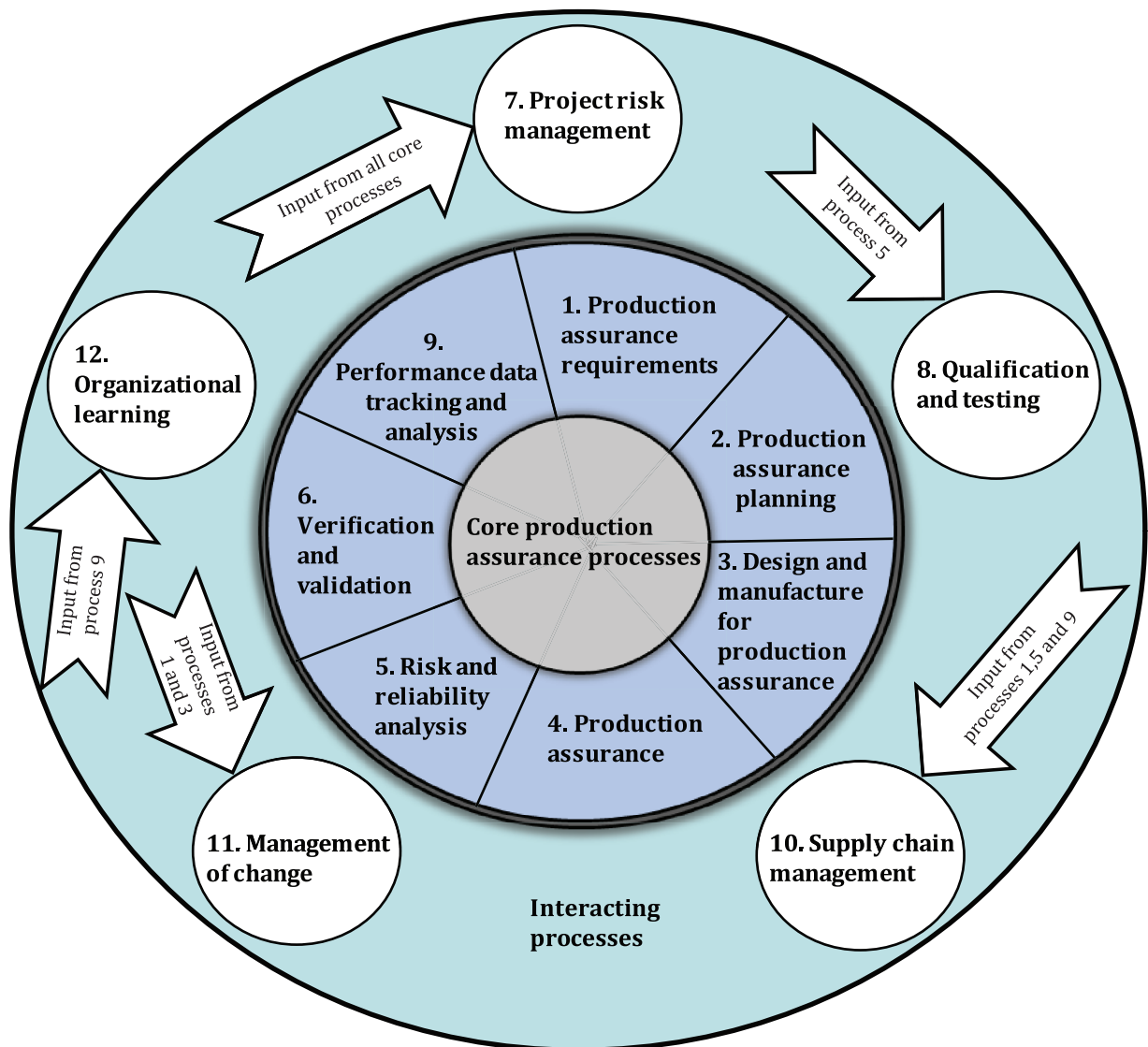
- **Authorities/regulatory bodies:** These organizations can use this document to apply standardized PE reporting from operators.
- **Consultants:** They can use this document to conduct production performance analyses, including benchmarking, and to support and advise operators/owners, authorities/regulatory bodies, investors and financial institutions.

4.2 Framework conditions

4.2.1 General

Production assurance is performed to enable cost-effective and safe operations and a variety of production assurance activities can take place during the life cycle phases. ISO 15663:2021, Table 1 defines such life cycle phases for an asset/project, and these phases are also reflected in ISO 20815:2018, Table 2. ISO 20815:2018 provides requirements and recommendations for undertaking such activities across the different life cycle phases including life cycle phase 'Operate'. [Figure 1](#) illustrates processes that are defined as core production assurance processes and that are interacting processes. Calculation and reporting of PE is part of the core production assurance processes covered by ISO 20815:2018, more specifically part of Process 9 – 'Performance data tracking and analysis', as illustrated in Figure 1, and described in more detail in ISO 20815:2018, Clause B.7. Thus, the principles and requirements applicable to production assurance (see [3.1.37](#)) described in ISO 20815:2018 shall also apply to the calculation and reporting of PE in the life cycle phase 'Operate', see also ISO 20815:2018, Table 2.

While process 9 also includes performance data tracking and collection for equipment failures as covered by ISO 14224:2016 with a view to provide feedback of reliability data (ISO 14224:2016, 3.82) into production performance analyses, PE calculation and reporting focuses on the production loss at installation level resulting from failures, maintenance activities and other events. The reporting of the production loss represents a direct relationship to the business performance factors such as lost revenue and OPEX.



NOTE This is a reproduction of ISO 20815:2018, Figure 4.

Figure 1 — Core and interacting production assurance processes

The objectives and use of PE reporting can include:

- basis for establishing PE target (Process 1 – Production assurance requirements);
- comparison of actual PE with performance objectives and performance requirements (production availability targets) (Process 4 – Production assurance);
- identification of the production loss categories (i.e. type of activity or event) that contribute to production loss;

A further analysis of the production loss contributors is necessary to identify cost-effective technical and/or operational mitigating measures. The production loss related to asset elements and the relevant systems and equipment classes are therefore part of the analysis (Process 4).

- benchmarking with other similar production facilities (Process 4);
- contribution to organizational learning (Process 12).

This document also covers to some extent forecasting of PE in the operating phase (see [5.2.1](#)). Production availability predictions performed during field development (i.e. life cycle phases 'Select' and 'Define' as defined in ISO 15663:2021) are covered by ISO 20815:2018. Such predictions will typically use analysis techniques as described in ISO 20815:2018, Clause I.5 and will be based on technical and operational assumptions prior to production start-up.

Conformance to this document implies that an operator has a production performance system in place for calculation and reporting of PE and production loss.

ISO 14224:2016 and ISO 20815:2018 provides requirements and guidance for input data categorization for use in calculation and reporting of PE as described in this document. See further information in [Annex A](#), [Annex C](#) and [Annex D](#).

4.2.2 Quality assurance

The operator should have a QA process in place to ensure accurate calculation and reporting of PE (and IE if needed). This QA process should include the necessary and sufficient checks to verify that all data (see [Annex A](#) and [D](#)) required for such reporting is complete and accurate. The QA activities should be performed at an appropriate time interval (e.g. daily verification of any production loss event recorded and monthly/yearly verification of PE calculation and reporting) or take place as per defined QA review criteria to ensure the following:

- a) production loss events are recorded within the main production loss categories;
- b) production loss events are correctly allocated and categorized;
- c) production loss events lasting across time interval reporting can need special attention;
- d) production loss events related to turnaround and modification activities (see [8.3](#) and [8.4](#)) will need appropriate attention;
- e) production volume to be used in the PE calculation at the appropriate PE measurement points is accurately established (see [6.3](#));
- f) regulatory reporting requirements or requirements agreed with external stakeholders are met;
- g) production potential remains valid or requires adjustment (including possible retrospective changes);
- h) requirements within this document are conformed with.

NOTE The source input data with assumed proper quality are generated from normal business activities and are as such not subject to the above-mentioned PE-specific QA.

4.2.3 HSE considerations

The balance between HSE and PE always requires priority on health, safety and environmental constraints. HSE considerations are therefore important when optimizing PE and to ensure conformance with a minimum set of HSE requirements.

How and when to reflect HSE when allocating the production loss for PE calculation can vary depending on the type of installation and operational framework. It is important to report and monitor such production loss to show conformance with the HSE requirements. This is illustrated by the following examples:

- Some HSE-related production loss categories (e.g. G2) will apply when production shutdown is needed for safety contingency reasons upon a potential accidental event or if an actual accident causes production shutdown.
- An environmental related production loss category (i.e. G4) will apply when unplanned partial or total production shutdown is needed to accommodate environmental permits.

- Various production loss categories (e.g. A5 and D1) can apply if a safety critical equipment (see [3.1.46](#)) has a critical equipment failure and thus unable to maintain safety function and it requires production shutdown.

By use of the PE reporting requirements and guidance in [Annex A](#) and [Annex D](#), the contributing factors of production loss can be identified and enable correct improvement measures to be taken that also support the HSE requirements. [Table A.1](#) and [Table D.1](#) provide further information about how production loss categorization documents any HSE related unplanned events and safety systems down time that affects production (or injection), i.e. HSE requirements conformance. Flaring restrictions in PE reporting are provided in [6.7.4](#). HSE related decision criteria (e.g. regulatory safety requirements and company HSE targets) can thus be explicitly reflected in PE reporting and show prudent operatorship.

These HSE considerations for the purpose of PE calculation and reporting can require support from risk management, risk analysts and technical HSE personnel.

NOTE See ISO 20815:2018, Clauses C.2, F.4, and I.20 for further guidance.

4.2.4 Sustainability and climate change considerations

Production efficiency within petroleum, petrochemical and natural gas industries can be impacted by sustainability and climate change considerations primarily associated with their carbon footprint. When setting PE targets and reporting PE performance, sustainability and climate change should therefore be considered.

The carbon footprint of a product (as defined in ISO Guide 84:2020, 3.1.32) should be reflected within its production performance objectives (e.g. PE targets) and should be addressed through PE calculations and reporting. As an example, GHG emissions (as defined in ISO Guide 84:2020, 3.1.13) are included in production loss category G4 (see [Table A.1](#)), as defined in accordance with ISO 20815:2018, which captures production loss due to flaring restrictions (see also [6.7](#)). Mitigations and adaptations related to sustainability and climate change (as outlined in ISO Guide 82:2019 and ISO Guide 84:2020) throughout the lifetime of an installation can also impact PE targets and PE reporting.

NOTE See IOGP report 437 [\[15\]](#) for sustainability reporting guidance.

4.3 Business category

Calculation and reporting of PE is applicable to all business categories and installation categories as shown in [Table 1](#). This table shows installations at taxonomic level 3 (see ISO 14224:2016), although emphasis in this document is on installations within the upstream business category.

[Table 2](#) shows a further subdivision at plant/unit level for upstream (E&P) installations based on Table A.2 in ISO 14224:2016.