



ISO/TC 67

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

Secretariat:

American Petroleum Institute, 1220 L Street NW, Washington DC 20005 USA

Tel. +1 202 682 8000 Fax. +1 202 962 4797

ISO/TC 67 N 932

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**Comments returned on ISO/CD 20815, *Petroleum, petrochemical and natural gas industries —
Production assurance and reliability management (67 N 911)***

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Template for comments and secretariat observations

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1	2	(3)	4	5	(6)	(7)
MB¹	Clause No./ Subclause No./ Annex (e.g. 3.1)	Paragraph/ Figure/Table/ Note (e.g. Table 1)	Type of comment²	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
BR	Scope	Title	Ed	Petroleum, petrochemical and natural gas industries - Production assurnace and reliability management	Petroleum, petrochemical and natural gas industries - Production assurance and reliability management	
BR	Copyright Notice		Ed	[Indicate the full address, telephone number, fax number, telex number, and electronic mail address, as appropriate, of the Copyright Manger of the ISO member body responsible for the secretariat of the TC or SC within the framework of which the working document has been prepared.]	[Indicate the full address, telephone number, fax number, telex number, and electronic mail address, as appropriate, of the Copyright Manager of the ISO member body responsible for the secretariat of the TC or SC within the framework of which the working document has been prepared.]	
BR	General		Te	Turnarounds are not very well treated in the standard.	Make it more explicit in the standard including it in the tables in the chapters 5 and 6.	
BR	General	Bibliography	Te, Ge	Some references mentioned in the text (including annexes)are not presented in the Bibliography.	Complete the references as required.(for example, ISO 14224 is not presented in the Bibliography)	
BR	Main part of the standard		Te	Abandonment and/or decommissioning or disposal (as per IEC 60300-3-3) are not considered as a life cycle phase.	Include or explain the exclusion in Scope (Clause 1), subclause 4.3 and table 4.3-2.	
BR	Main part of the standard	General	Te	Human factors, including management, evaluation and qualification , are not well treated in the main body of the standard; nevertheless, they are strongly associated with production assurance, reliability performance and risk management. Hence, this apparent omission is not recommended and more emphasis should be done in the main body of the standard.	Provide more emphasis for human factor matter in the standard, giving its relation to production assurance reliability performance and risk management.	
BR	Main part of the standard	General	Te	Annexes are not sufficiently mentioned in the main body of Standard.	Include in the clauses, when applicable, the recommendable tools or methods as described in the annexes.	
BR	1	Last paragraph	Te	Apparently IEC 60701 is not related with this document or the number is wrong.	Check this reference: IEC60701 series.	
BR	1	Whole	Te	The scope does not give to reader a precise idea of the	Rewrite as, e.g.: This International Standard	

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		clause		standard.	<p>provides requirements and guidelines for systematic and effective planning, execution and use of reliability technology for all of the life cycle phases of a project to achieve cost-effective solutions and production assurance. It is structured around the following main elements:</p> <ul style="list-style-type: none"> • production assurance management for optimum economy of the facility through all of its life cycle phases, while also considering constraints arising from health, safety, environment, quality and human factors; • planning, execution and implementation of reliability technology; • the application, analysis and tracking of reliability and maintenance data for components and systems over the operational and other related phases; • reliability based design and operation improvement; • establishment and use of reliability clauses in contracts. <p>This international standard focuses on production assurance of petroleum, natural gas and petrochemical industries and their associated activities. For standards on equipment reliability and maintenance performance in general see IEC 60300-3-1 and the IEC60701 series.</p>	
BR	3		Te	IEC 60 500-191	IEC 60050 -191	
BR	3		Te	There is no definition for Risk or its several meanings which are related to this Standard	Define Risk (for example, as in API RP 581).	

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BR	3		Te	Risk register is several times mentioned in the process tables but it is not clear its meaning.	Define Risk register.	
BR	3		Te	<p>The term MFFOP is mentioned in page 30, subclause 9.2. but is not defined.</p> <p>For example, The BP Subsea Reliability Strategy, a guide for BP leaders present the following definition:</p> <p>MFFOP " System Hazard rate that guarantees a specified minimum failure-free operation period so that the probability of premature failure is below an agreed limit.</p> <p>Note: Its used in preference of MTTF because in case of non-constant hazard rate the MTTF measure can be misleading".</p>	Define MFFOP and include in 3.2	
BR	3.1.11		Te	It is referred to EN 13 306 but IEC 60050-191 has almost the same definition, i.e.: the circumstances during design manufacture or use which have led to a failure (the word maintenance is not mentioned)	Change the reference from EN 13 306 to IEC 60050-191	
BR	3.1.31		Te	Check consistence with IEC 60050-191 standard as far as performance requirements can also be applied to other than only reliability items, e.g. maintainability performance.	indicative level for the performance one wishes to achieve	
BR	3.1.32		Te	Check consistence with IEC 60050-191 standard as far as performance requirements can also be applied to other than only reliability items, e.g. maintainability performance.	required minimum level for the performance of a system or in a asset development project	
BR	4.2 and 4.4	Table 4.4-1	Te	ISO 15663, part 1 to 3, are mentioned in item 4.2 as reference for optimisation process but they are not listed as alternative standards in item 4.4, Table 4.4-1.	Considered inclusion of ISO 15663, part 1 to 3, in Table 4.4-1	

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BR	4.2	Last sentence in the 1 st paragraph	Te	According to this ISO 15663 shall be included in chapter 2. However, for economic assessment, there is another alternatives to evaluate.	This International Standard can therefore be considered together with ISO 15663, part 1 to 3.	
BR	4.2	Figure 2	Te	The figure does not emphasize the optimization process suitably. It emphasizes project options and constraints only. End selection should not have a diamond form.	Revise the figure by adding a loop or something representing that all possible options are evaluated according to performance evaluations and economical solutions and based on a criteria selection of the project owner(s) - one option is selected.	
BR	4.3.1	Whole item	Te	The objective of the PAP is not very well distinguished from the objective of the standard. More emphasis shall be stated that the PAP is a management tool only. Also some link or clarification between this item and Annex A should be stated.	<p>Rewrite as, e.g.: A production assurance programme (PAP) shall serve as a management tool in the process of complying with this standard. It should be a kind of living document established for the various life cycle phases of an asset development project, updated at major milestones as required as well as being established for assets already in operation. The PAP shall contain:</p> <ul style="list-style-type: none"> • proper systematic planning of production assurance/reliability work within the scope of the programme; • definition of the optimisation criteria; • definition of performance objectives and requirements, if any; • description of the production assurance activities necessary to fulfil the objectives, how they will be carried out, by whom and when. These shall be further outlined in separate production assurance or reliability activity plans; • statements and considerations on interfaces of production assurance and reliability with 	

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					<p>other activities.</p> <p>The PAP shall be at a level of detail, which facilitates easy updating and overall co-ordination. The Annex A informs possible contents of a PAP.</p>	
BR	Table 4.3-1	Risk Category	Te	<p>Risk categories “Low” and “Low-medium” of Table 4.3-1 and Low Risk Levels of Table 4.3-2 are not compatible.</p> <p>Other combinations than those shown in the table may give different risk levels.</p> <p>Novel technology not necessarily means a high level risk.</p>	<p>1) Substitute categories of Table 4.3-1: - “Low-medium” to “Low or Medium”; - “Medium-high” to “Medium or High”.</p> <p>2) And insert a note: “Risk categorisation should be obtained through the appropriated combination of the column elements taking into account their importance on project outcomes.”</p> <p>3) Fill the blanked spaces in the “Novel Technology” line with appropriated attributes.</p>	
BR	General	4.3.2 and others	Te	Risk level is sometimes treated as risk class and sometimes as risk category.	Consistence among these terms should be provided within this standard.	
BR	4.3.2	4 th paragraph	Ed	“... between the three risk categories.”	“... among the three risk categories.”	
BR	4.3.3	Table 4.3-2	Te	Despite this table can be considered as an example, it is not clear the distinction among different project risk levels.	<p>Exclude the Main Process number 5 from low risk projects.</p> <p>Exclude the Main Process number 6 from medium risk projects.</p>	
BR	4.3.3	4 th paragraph	Ed	“...they can omitted.”	“...they can be omitted.”	
BR	5 and 6		Te	If a flowchart (where the inputs come from and outputs go), is available after each process table it will add a	Include flowcharts.	

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				visual help to the understanding.		
BR	5 and 6		ed	Second line of tables usually refer to all phases. It should be better mention the phases.	Replace all phases as described	
BR	5.5	Content	Ed	Uniformity of format: 5.5 Process 4: Reliability Verification and Validation	5.5 Process 4: Reliability verification and validation...	
BR	5.2 to 5.7	Tables 5.2-1 to 5.7-1	Te	The organizations of these tables are well established with fields for Inputs, Activities and Outputs. Nevertheless, the contents for different tables or process are very similar and may lead to wrong or difficult interpretation. See below other comments related to these tables.	Rewrite the tables putting more emphasis for Input, Activity and Output fields with corresponding processes.	
BR	5.2	Table 5.2-1	Te	The Inputs and Output texts are very similar for Feasibility and Concept phases and it is quite difficult for the reader to understand the idea.	Rewrite and improve Inputs and Output texts for Feasibility and Concept phases making more clear distinctions between Inputs and Outputs.	
BR	5.2 and 5.3	Tables 5.2-1 and 5.3-1	Te	The Objectives written for Feasibility and Concept phases in tables 5.2-1 and 5.3-1 are the same.	Rewrite the Objectives for Feasibility and Concept phases in tables 5.2-1 and 5.3-1 making some distinction between them or including more emphasis according to their corresponding processes, i.e. Reliability requirements and Risk and reliability in design, respectively.	
BR	5.3	All paragraphs, mainly the second one	Te	This process is denominated as Risk and reliability in design but in the text references are made on reliability only.	Change the process title for Reliability in design <u>or</u> rewrite the sub clause text making references for reliability and <u>risk</u> .	
BR	5.2 to 5.5	Tables 5.2-1 to 5.5-1	Te	It is not clear the meaning of some texts in these tables pointing, e.g. B Equipment Analysis, C Production Availability Analysis, L Risk register, I Reporting, J follow up the requirements, etc.	Rewrite making them more clearly.	
BR	5.4	Table 5.4-1, Activities and Output fields	Te	It is mentioned several times something as 'requirements 1, 2 and 3 in the PAP'. However it is not clear what 1, 2 and are referred (perhaps clauses in the standard?, in the PAP?, ...).	Rewrite the text making it more clearly on what 1, 2 and 3 might be referred.	

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BR	5.6		Te	Performance tracking and analysis is related to performance measure but Annex C is not mentioned.	Annex C or its purposes might be mentioned in this item.	
BR	5.7	First paragraph	Ed	...feasibility and procure phase where...	...feasibility and procurement phases where...	
BR	6.6	1 st paragraph, 3 rd line	Ed	the past in not repeated.	the past is not repeated.	
BR	6.3 and 6.6	General	Te	The experience has shown that some failure modes are more related to procedures and/or environment and they may not be evaluated suitably by lab/qualification tests, e.g. hydrates.	Include a note/warning in sub clauses 6.3 and 6.6 giving the following idea, e.g.: Proper evaluation of relevant failure modes should also consider operational experience of similar components in addition to the lab/qualification test results in order to catch possible failure events that are more strongly associated with some particular operational conditions and/or procedures and, normally, not revealed by lab tests.	
BR	7.2.1	5 th bullet point in the first paragraph		There are other alternatives for selecting facilities apart from LCC.	Rewrite as, e.g.: enable selection of facilities, systems, equipment, configuration and capacities based on economic assessments ;	
BR	7.3.2	3 rd paragraph 3 rd line	Ed	made to ch clause 6.	made to clause 6.	
BR	7.3.2	4 th paragraph 2 nd line	Ed	...judgement. REGOP sessions ...	Define REGOP and include in 3.2	
BR	7.3.4		Ed	...design basis, P&ID, PFD, O&M strategies, ...	Define terms and include them in 3.2	
BR	8.2	2 nd paragraph	Te	It is recommended to add other examples of database in the standard in addition to OREDA: 'Data from event databases (e.g. OREDA database)...'	Data from event databases (e.g. OREDA , WellMaster, ... database)...	
BR	9.1	1 st	Te	In this sub clause references are made on the	Include some summary/information on the main	

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		paragraph		requirements and specification of production assurance but it is not clear their links with contracts, which may be with a supplier third part, service companies, etc.	purpose of the item 9 and its relation with contracts.	
BR	B.15	End of chapter	te	API RP 581 – Risk based inspection is considered a world reference.	Include API RP 581 as a reference	
FR	3.1.2	Availability	Te	Along to this definition, Reliability ins a particular case of Availability. This is a mistake	Ability of an item to be in a state to perform a required function under given conditions at a given instant or, in average , over a given time interval, assuming	
FR	3.1.14	Failure rate	Te	This is not the mathematical definition of a failure rate	use the definition from IEC 60050-191: "the limit, if this exists, of the ratio of the conditional probability that the instant of time T, of a failure of an item falls within a given time interval (t+Δt) and the length of this interval ΔT, when W=ΔT tends to zero, given that the item is in an upstate at the beginning of the time interval" or hazard rate of a reliability function Note : a statistical estimator of the failure rate of one item is the ratio of the number of failure by the time of observation	
FR	3.1.24	MTTF	ed	this clause is about MTBF	change MTTF in MTBF in the NOTE	
FR	9.2	Minimum Failure Free Operating Period	Te	In the probabilistic world the "minimum free operating period" (MFFOP) is always "zero" and therefore this parameter is not relevant. What is relevant is the probability that the MFFOP is greater than a given value T. This is the reliability at time T : R(T) NOTE : MFFOP belongs to these "new" parameters without sound mathematical definition	Cancel this parameter or Give a sound mathematical definition of its meaning : a minimum period of time where production interruptions have to be avoided ?	

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FR	9.2	Survival probability	Te	"Survival Probability" has to be defined if it is different from the classical system "Reliability"	Reliability of the production system ? Or Reliability at MFFOP : R(MFFOP) ? Anyway, give a sound mathematical definition of this parameter	
FR	B.7 & B.8	Hazop & POP	Ed	these analyses are of the same type as AMDEC	put them before FTA (B.3)	
FR	B.3	FTA	Te	FTA deals only with two state systems and is not very useful for production availability studies.	Add a NOTE : as FTA deals only with two state systems it can be used to analyse the reliability of the production system but not relevant to asses its production availability.	
FR	B.3	FTA	Te	The parameter "Probability of failure upon demand (γ)" is used her in a correct way contrarily with what is done in the worldwide used IEC61508 and IEC 61 511 standard. This can introduce confusion.	- probability of failure upon demand (γ) , i.e. probability of failure due to the demand itself (this must not be confused with the PFD introduced in other standards for the "probability of not functioning on demand)	
FR	B.3	FTA	Te	Handling test intervals with fault trees lead easily to miscalculation. In particular the commonly used PFDavg ($\Lambda * \tau$)/2 leads to non conservative estimations. A warning is needed	NOTE : FTA allows only to calculate the instantaneous unavailability of a system. Therefore calculation performed with averaged values can be irrelevant.	
FR	B.5	Simulation	Te	There is a confusion between a calculation mean (Monte Carlo simulation) and a modelling mean allowing to represent the behaviour of the production system like : improved RBD, State graph, flow network, finite state automata, formal languages, ...	Change the title into : Production availability : Behavioural models allowing Monte Carlo simulation Behavioural models allow to model the dynamic behaviour or the production systems with respect to failure occurrence, maintenance, reconfiguration operating and flaring policies, etc. These models comprise improved RBD, State graphs, flow network, finite state automata, Petri nets, formal languages, ... These models cannot be calculated by analytical	

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					ways and Monte Carlo simulation has to be used. Monte Carlo simulation is a technique in which the events (failure, repair, day, night, reconfiguration, spare parts availability, ...) are simulated by using random number generators according to probability distributions of each events. Monte Carlo simulation is well suited for production availability prediction of a production facility. Behavioural models can be used to model a variety of situations including complex failure and repair distributions, effects of different repair policies, redundancy, operational aspects, etc...	
FR	B.4 & B.5	Paragraph missing	Te	Between FTA and Models for Monte Carlo simulation, Markovian models have to be introduced	Title :Production availability : Behavioural models allowing analytical calculation Practically only Markov processes belong to this category. Because of the combinatory explosion of states, Markov graphs can only be used in order to model the behaviour of small systems. Rewards corresponding to the production levels can be associated with the various states in order to perform production availability calculations in an analytical way.	
FR	B.11	Software Reliability	Te	IEC 61508 -3 is devoted to the design of "high Integrity" (SIL) software. A reference can be useful here	Add a reference to IEC 61508 part 3.	
FR	B.12	Common Cause Failure Title and 2 nd §	Te	CCF and Common Mode failures are a very important topic likely to decrease production availability. It is necessary to insist a little bit more on them	Title : Common Cause and Common mode failure modelling. Change "Regularity prediction failures" in : Production Availability prediction should include a thorough identification, analysis, evaluation and modelling of common cause and common mode failures.	

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FR	B ??	Compensatory measures	Te	Compensatory measures when the production is partially or completely lost are of utmost importance when assessing production availability. A § should be added	Title : Compensatory measures on degraded conditions When degraded production conditions occur, some compensatory measures can be taken in order to retrieve completely or partially the production during the repair of the failed components (back ups, system reconfiguration, ...). This cans have a big impact to reduce the losses and therefore these compensatory measures should be thoroughly identified, analysed, evaluated and modelled	
FR	Annex C	Figure C.1	Te	Reliability and maintainability of items lead both to the availability and reliability of the system including this item. Reliability must be added on this figure in order to make the link with the "Survivability and MFFOP" parameters (which needs a sound definition on another hand"	Above Availability (system) : add Reliability (System) add an arrow pointing on Survivability and MFFOP (above Production availability)	
FR	Annex E	Handling of uncertainty	Te	The production availability is a "random variable" therefore it is distributed along to a certain probability law and there is an uncertainty about what is going to happen in the actual life. The parameters used for the calculations are not perfectly known and introduce another level of uncertainty in the predictions The operating, maintenance, .. philosophies are not well known in preliminary estimation and this introduce another level of uncertainties The model used leads also to another level of uncertainties	Split more clearly the various sources of uncertainties into : 1- uncertainty due to the fact the production availability is a random variable an is, therefore, naturally spread around its average 2-uncertainties due to poor reliability data collection (ref to ISO 14224) 3-uncertainties due to bad knowledge about the process modelled 4- uncertainties due to the limits of the model used (or of the analyst using the model)	

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FR	Miscellaneous		Ge	Flaring policy, spare parts policy have a strong impact on production availability an could be brought to light a little bit more		
NL	4.2	Last para	Ed	Typo	Change to: "The appropriate production assurance parameters are predicted and the preferred solution is identified based on an economical evaluation/analysis such as an NPV analysis or another optimisation criterion."	
NL	4.3.3	4 th para	Ed	Hyphen	Change to: "If the processes and activities listed in clause 4 and clause 5 can be demonstrated to be non-value adding for a specific delivery project, they can omitted."	
NL	4.3.3	7 th para	Ed	Hyphen	Change to: "This is to avoid reliability activities that are redundant, non-value adding or too extensive"	
NL	4.3.3	7 th para	Ed	Grammar and typos	Change to: "An overview of the production assurance processes is given in Table 4.3-2, while activity requirements for the processes are given in clause 5. The table provides recommendations (indicated by crosses – "x") on what processes should be performed as a function of the project risk categorisation. The table also provides recommendations (indicated by crosses – "x") as to when the processes should be applied (in what life cycle phase)."	
NL	4.4	1 st para	Ed	punctuation	Delete punctuation after the word "clause"	
NL	4.4	4 th para	Ed	Upper case	Change to: "However compliance to this International Standard is limited to the listed processes and activities in clause 4, 5 and 1, i.e. the alternative standards are not normative for this International Standard ."	
NL	4.4	6 th para	Ed	Sentence construction	Change to: "Please note that ISO 14224 compliance is listed as a normative reference,	

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					hence not included in the table below.”	
NL	Table 4.4-1		Te	Changes to X (crosses)	Insert “X” in cell “1. Reliability Requirements” plus “IEC 60300-3-4”. Insert “X” in cell “4. Reliability Verification and Validation” plus “IEC 60300-3-4” Delete “X” in cell “2. Risk and Reliability in Design” plus “IEC 60300-3-10”	
NL	5.1	2 nd para	Ed	Typo	Change to: “Other projects than asset developments, e.g. drilling units, transportation networks, major modifications, etc. will have phases that more or less coincide with those described in the following”	
NL	5.2	1 st para	Ed	Sentence construction	Change to: “Unnecessary limitations in the form of unfounded performance requirements shall be avoided to prevent otherwise favourable alternatives from being rejected during the optimisation process.”	
NL	5.2	Last para	Ed	Sentence construction	Change to: “Optimal production availability for field layouts requires that the present overemphasis on CAPEX is avoided, and it is recommended that this is achieved through long term partnering between both suppliers and operators and suppliers and sub-suppliers.”	
NL	Table 5.2-1		Ed	Row “input”, column “Concept phase” references now obsolete activity identifiers	Change: “Activity: C Production availability Analysis” to “Activity: Production availability Analysis” Change: “Activities: H Planning” to “Activities: Planning”	
NL	5.3	2 nd para	Ed	Sentence construction	Change to “The objective is to define a process that can be used to integrate reliability considerations into the design process, thus representing a pro-active approach.”	

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NL	5.3	3 rd para	Ed	Sentence construction	Change to "The feasibility and concept phase reliability activities shall focus on optimisation of overall configuration and identification of the critical subsystems, while attention to the detail of the critical subsystems will increase in the engineering phase."	
NL	Table 5.3-1 and 5.4-1 and 5.5-1 and 6.3-1		Ed	Table references now obsolete activity identifiers	Remove identifiers H, I, J, C, B and L from: H Planning I reporting J follow up C Production Availability Analysis B Equipment Reliability Analysis L The risk register In various places	
NL	7.3.1		Te	The recommendation indicates the "may" is a "should"	Delete "and is recommended in some cases".	
NL	7.3.2	2 nd para	Ed	Grammar	Change to: "The system description shall describe, or refer to documentation of, all technical and operational aspects that are considered to influence the results of the production assurance analysis and that are required to identify the system subject to the analysis."	
NL	7.3.2	3 rd para	Ed	Superfluous "ch"	Change to: "Regarding collection and use of reliability data, reference is made to clause 6. "	
NL	7.3.5.3	3 rd para	Ed	Wording	Change to: "In order to take account of the effects of compensating measures, it may be necessary to establish the criticality list based on successive sensitivity analyses where the contribution from each event is set to zero."	
NL	7.3.6	Last	Ed	Wording	Change to: "Recommendations may also be	

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		sentence			categorised by whether they affect the frequency or the consequence of failures/events.”	
NL	8.1.1	2 nd sentence	Ed	Colon missing	Change to: “The purpose of establishing and maintaining databases is to provide feedback to assist in:”	
NL	8.3	3 rd sentence	Ed	Typo	Change to: “The type of installation and operation will determine the format and structure of performance reporting. Annex C outlines types of events to be covered for a production facility.”	
NL	9.2	2 nd para	Ed	Typo	Change to: “Requirements should be realistic and should be compatible with the technological state of the art. It shall be stated whether the specification is an objective or a requirement.”	
NL	9.4	2 nd sentence	Ed	Typo	Change to: “It should be specified that the operator acknowledges the responsibility to monitor performance and reliability in use and exchange field experience with their suppliers.”	
NL	B.2	Overall need for info	Ed	Typo	Change to: “Estimation of probability of occurrence (based on experience or public databases)”	
NL	B.3	Objective of analysis	Ed	Sentence construction	Change to : “- build a graphical representation of a system representing the combinations of the individual components failures which lead to whole system failure and by doing so, obtain the Boolean equation linking the undesirable event (at the whole system level) to the failure of the individual components;” Change to: “- analyse qualitatively the reliability/availability of the system by identifying the combinations of basic failures leading to the undesirable event, These combinations of failures are the so-called "minimal cut sets" (coherent FT) or "prime implicants " (non coherent FT);”	

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					Change to: “- analyse semi-quantitatively the reliability/availability of the system by sorting its minimal cut sets (or prime implicant) in order of decreasing probabilities;”	
NL	B.3	Overall need for info: first sentence	Ed	punctuation	Correct “, .”	
NL	B.4	Analysis description	Te/Ed	Sentence construction and unnecessary limitation	Change whole clause to: “The application of Reliability block diagram (RBD) is similar to that of the Fault Tree Analyses (FTA). RBD can be used for predictions of production availability for a complete plant.”	
NL	B.6	2 nd sentence	Ed	Wording	Change to : “Special production assurance design reviews should be considered, or production assurance aspects should be included in other design reviews.”	
NL	B.7	2 nd sentence	Ed	Wording	Change to: “Being useful from a production assurance point of view, the HAZOPs may also be used to identify safe alternative ways of operating the plant in an abnormal situation to avoid shutdown.”	
NL	B.8	1 st sentence	Ed	Wording	Change to: “POP denotes a thorough review of failure and downtime scenarios in the production system to be analysed. The objectives with the review include: ”	
NL	B.9	Last bullet	Ed	Hyphenation	Change to: “ in-service reliability demonstration”	
NL	B.9	Last 2 sentences	Ed	Typo	Change to: “Accelerated lifetime testing involves overstressing in terms of environmental and operational conditions, which provokes different or alternative failure modes and degradation mechanisms compared to normal operating conditions. I.e. it has proved extremely challenging to reproduce normal lifetime degradation from	

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					accelerated lifetime testing.”	
NL	B.12	Last sentence	Ed	Wording	Change to: “ Production assurance predictions should include an evaluation of common cause failures.”	
NL	B.14	1 st sentence	Ed	Typo	Change to: “In an RCM analysis which has the purpose to establish the (preventive) maintenance programme in a systematic way, the following steps are normally covered.”	
NL	B.14	2 nd bullet	Ed	Wording	Delete: “to a larger or minor degree”	
NL	B.14	3 rd bullet	Ed	Wording	Change to: “identification of failure causes and mechanism for critical fault modes;”	
NL	B.14	4 th bullet	Ed	Wording	Change to: “definition of the type of maintenance based on criticality of the failure, the failure probability, the maintenance cost, etc.”	
NL	B.18	2 nd para	Ed	Wording	Change to: “All models of this kind can be used to calculate single probabilities that are inputs in different methods used in risk and production assurance analyses such as for the basic events in fault tree and RBD analysis.”	
NL	B.19	1 st para	Ed	Wording	Change to: “The format of the input shall be suitable to calculate the LOSTREV as part of the production assurance analysis, whilst CAPEX and OPEX are normally covered in the overall LCC analysis.”	
NL	B.21	Immediately below table	Ed	Wording	Change to: “The classification is used to highlight which parts and functions have to be carefully scrutinized in the development process”	
NL	Table C.9.4-1	E3	Ed	Wording	Change to: “Activities developed to repair equipment that is essential to proceed with normal operations, including possible safeguards on the well for repairing and others, e.g. setting a temporary plug in the well	

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					pulling/running/repairing/re-installing the BOP, other repairing related activities.”	
NL	Table C.9.4.3	A0	Ed	Wording	Change to: “Losses arising from equipment failures, power, instrumentation , utilities.”	
NL	Table C.9.4.3	A3	Ed	Space too many	Change to: “Losses caused by production constraints due to commercial aspects of the business”	
NL	Annex D	Under: Criterion for inclusion in analyses	Ed	Wording	Change to: “In general, catastrophic events should not be included in production availability analysis, but should be in risk and financial analyses. A criterion for exclusion from production availability analyses may be as follows:”	
NL	Annex E	1 st para	Ed	Wording	Change to: “To structure and reduce this uncertainty we develop a model which describes important phenomena and incorporates relevant experience based data.”	
NL	Annex E	Under: the downtime pattern of equipment and systems	Ed	Wording	Change to: “When will an equipment failure occur and what will be the consequences on production ?”	
NL	Annex E	Under: the time period considered	Ed	Colon missing	Change to: “Important aspects are:”	
NL	Annex E	Under: system definition	Ed	Typo	Change to: ” The initial project phases will provide limited access to reliable information on technical solutions, production and sales profiles, operating and maintenance philosophies, logistics conditions etc.”	
NO	1	Heading	ed	“Production assurance..” is wrongly spelled	“Production assurance”	
NO	3.1.24	NOTE	ed	“The MTTF of” should be “The MTBF of “	“The MTBF of”	

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NO	3.1.24, 3.1.25		ed	A short explanation of the difference between the terms	Including e.g for MTBF; "..., calculated from the moment the unit fails" and e.g. for MTTF; ... "calculated from the moment the unit is performing its required function"	
NO	3.1.37	NOTE 2	ed	The space and letter size differ from the other NOTES		
NO	3.2		ed	The description of HAZID differs from the other as it starts with "H" and not small letter, "h"	Let all the descriptions be identical with regards to small letters	
NO	3.2		ed	LNG is described as gas and LPG is described as gases	If no reason for the difference, they should be identical	
NO	3.2		ed	The list does not include the MTBF term, included elsewhere in the document		
NO	3.2		ed	The list does not include the HSE term, included in 4.2, Figure 2		
NO	4.3.2	Table 4.3.1	ed	In column nr 4, in the heading, "Organisational" includes a split after the last "l"		
NO	4.3.3		ed	After the last paragraph, a stop is missing		

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