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PART IV

SUPPLEMENTS TO THE SERIES E RECOMMENDATIONS RELATING TO TELEPHONE NETWORK MANAGEMENT

AND TRAFFIC ENGINEERING

MONTAGE: PAGE PAIRE = PAGE BLANCHE

Supplement No. 1

TABLE OF THE ERLANG FORMULA

Table of the
Erlang loss formula

(Erlang No. 1 formula, also called Erlang B formula)

Loss probabilities : 1%, 3%, 5%, 7%.

Let *p* = the loss probability *y* = the traffic offered (in Erlangs) *n* = the number of circuits

–v’2P’ –v’3p’ Formula: $E_{1,\,n}(y) = p =$ $$2o fIy nfR / fIn ! $$3u1 + [Formula Deleted] fIy 2 / ! + fIy nfR / fIn ! $$3e

H.T. [T1.1]

Unable to convert table **Table 1 [T1.1], p.**

Supplement No. 2

CURVES SHOWING THE RELATION BETWEEN THE TRAFFIC OFFERED

AND THE NUMBER OF CIRCUITS REQUIRED

Figure 1, p.

Figure 2, p.

Supplement No. 3

INFORMATION ON TRAFFIC ROUTING IN THE INTERNATIONAL NETWORK

(Results from study in 1973-1976 of Question 11/XIII

concerning actual connections of international telephone calls

(For the text of this Supplement, see Supplement No. 7,

Volume II.2, *Orange Book* , Geneva, 1976)

Supplement No. 4

USE OF COMPUTERS FOR NETWORK PLANNING AND CIRCUIT GROUP DIMENSIONING

(For the text of this Supplement, see Supplement No. 8,

Volume II.2, *Orange Book* , Geneva, 1976)

Supplement No. 5

TELETRAFFIC IMPLICATIONS FOR INTERNATIONAL SWITCHING AND OPERATIONAL | PROCEDURES RESULTING FROM A FAILURE OF A TRANSMISSION FACILITY

1 Very considerable changes have occurred in the international network over the past decade. These changes have arisen mainly from:

— the growth in the number of long-distance routes;

— the growth in the number of circuits forming individual long-distance routes;

— the world-wide introduction of international automatic operation;

— technological developments associated with all aspects of the international network: switching unit design, transmission facility design, and routing and operational strategies;

— the integration into the international automatic service of the more isolated geographical areas and of centres having low-capacity international switching units.

2 The resultant multiplicity of circumstances and situations arising within the international network is now such that it is no longer possible to specify one single criterion for initiating corrective action to counter the loss of a transmission facility. Indeed, the failure of the whole, or part, of a transmission facility may manifest itself in a different manner to each of several Administrations affected by the failure.

3 Among the many aspects of international switching and operational procedures which can influence the degree of curtailment of service arising from a transmission-facility failure, i.e. which can reduce the ability of part of the international network to carry its designed traffic load successfully, the following are specifically stressed (their order has no particular significance):

— the introduction of fully automatic international operation, which means that the control of the network, formerly completely operator -controlled, now depends directly on subscribers' habits;

— the number of routes that could be affected by failure and their proportion of the total routes on the switching unit to which they are directly connected: the range can be from one whole route to a few circuits in each of many routes, depending on the method of allocating circuits to transmission facilities;

— the influence of any route, for which no alternative transmission facility exists, on the performance of the international switching unit to which it is connected;

— the effect on the grade of service of the switching unit itself due to the loss of a complete route or routes, or parts of several routes, directly connected to it;

— the methods of limiting the effect of failure on service by action within the switching unit or at preceding international or national switching unit, e.g. by code blocking or recorded announcements;

— the cause of the failure, and thus the possible restoration time, relative to the 24-hour traffic profile;

— the effect of a failure on overflow and automatic alternative routing strategies ;

— the use of diversity of international switching units;

— the use of diversity of international transmission facilities.

4 Attention is also drawn to four major factors of maintaining continuity of service:

— reliability ,

— diversity,

— network management , and

— any redundancy specifically provided to allow restoration of service.

5 Clearly, no practical transmission facility provided will give 100 per cent reliability, so it is inevitable that the other three factors will be involved to varying degrees in maintaining service. The interaction of these four factors will depend largely on the emphasis placed upon each of them by each Administration, thus reinforcing the view that the degree of corrective action that can be taken will depend considerably upon the investment policy (in materials and equipment) and forward-planning objectives of individual Administrations.

6 With respect to diversity, it is recommended that Administrations give consideration to the provision of an adequate number of paths for a particular route, with an adequate level of independence between the paths. Such independence could reduce the effect of a breakdown or other adverse event by confining it, as far as possible, to only one of the paths used by that route.

7 For the further assistance of Administrations in their study of those teletraffic aspects of international switching and operational procedure which influence the degree of curtailment of service and which arise from a transmission facility failure, these factors are included in Question 23/II related to continuity of service, accepted for study during the 1985-1988 Study Period.

Supplement No. 6

TERMS AND DEFINITIONS FOR QUALITY OF SERVICE, NETWORK PERFORMANCE, DEPENDABILITY AND TRAFFICABILITY STUDIES

CONTENTS

PART I
Dependability Vocabulary

1 Introduction

A consistent set of terms and definitions is required for the development and use of the various Recommendations addressing aspects relating the specifications, planning, data collection, analysis and evaluation of the dependability, including availability performance, reliability performance, maintainability performance and maintenance support performance. These needs address the whole range of operational and maintenance aspects as applicable to telecommunication networks, exchanges, transmission routes and channels, etc., independent of the types of services supported, including aspects of providing the necessary maintenance.

The vocabulary provided by this Supplement is also of importance in the handling of concepts related to quality of service and network performance. The conceptual relationships between quality of service and network performance to dependability and other item-related performances is shown in Figure 1. Further information on these performances is found in Recommendation E.800.

The vocabulary also provides the necessary linking to the performances of components and building blocks (hardware and software) of networks at any level of indenture (ref. definition 6019).

Figure 1, p.

For the quantitative application and determination of measures, the terms and definitions of Part II also need to be consulted.

2 Related Recommendations

E.600 — Terms and definitions of traffic engineering

E.800 — Quality of service and dependability vocabulary.

3 Basic concepts

3001 **item; entity**

F: entit´e; individu

S: elemento; entidad; ´item

Any part, device, subsystem, functional unit, equipment or system that can be individually considered.

Note 1 — An *item* | ay consist of hardware, software or both, and may also include people, e.g. operators in a telephone operator system.

Note 2 — In French, the term *entité* replaces the term *dispositif* previously used in this meaning, because the term *dispositif* is also the common equivalent for the English term ‘‘device’’.

Note 3 — In French, the term *individu* is used mainly in statistics.

3002 **repaired item**

F: *entit´e r´epar´ee*

S: *elemento reparado*

A repairable *item* | hich is in fact repaired after a *failure* .

3003 **non-repaired item**

F: *entit´e non r´epar´ee*

S: *elemento no reparado*

An *item* | hich is not repaired after a *failure* .

Note — A *non-repaired item* | ay be repairable or not.

3005 **required function**

F: *fonction requise*

S: *funci´on requerida*

A function or a combination of functions of an *item* | hich is considered necessary for the provisioning of a given *service* .

3006 **functional mode**

F: *mode de fonctionnement*

S: *modo de funcionamiento*

A subset of the whole set of possible functions of an *item* .

3007 **instant of time**

F: *instant*

S: *instante (de tiempo)*

A single point on a time scale.

Note — The time scale may be continuous as calendar time, or discrete, e.g. number of use cycles.

3008 **time interval**

F: *intervalle de temps*

S: *intervalo de tiempo*

All *instants of time* | etween two given *instants of time* .

3009 **(time) duration**

F: *durée*

S: *duración*

The difference between the end points of a *time interval* .

3010 **accumulated time**

F: *durée cumulée*

S: *tiempo acumulado*

The sum of *time durations* | haracterized by given conditions over a given *time interval* .

3011 **measure** (as applied in the study of reliability performance and related areas)

F: caract´eristique (probabilit´e); mesure (en fiabilit´e et domaines connexes)

S: medida (aplicada en estudios de fiabilidad y de aspectos conexos)

A function or quantity used to describe a *random variable* | r a *random process* .

Note — For a *random variable* , examples of *measures*
| re the *distribution function* | nd the *mean* .

3012 **operation**

F: exploitation

S: explotaci´on; operaci´on

Combination of all technical and corresponding administrative actions intended to allow an *item* | to perform a *required function* , recognizing necessary adaptation to changes in external conditions.

Note — By external conditions are understood, for example, service demand and environmental conditions.

3013 **modification** (of an item)

F: modification (d'une entit´e)

S: modificaci´on (de un elemento)

The combination of all technical and corresponding administrative actions intended to alter the *capability* of an *item* by changing, adding or deleting one or more *required functions* .

4 Performances

4001 **dependability**

F: s | ret´e de fonctionnement

S: seguridad de funcionamiento

The collective term used to describe the *availability performance* | nd its influencing factors: *reliability performance, maintainability performance* and *maintenance support performance* .

Note — *Dependability* is used only for general descriptions in non-quantitative terms.

4002 **availability performance**

F: disponibilit´e

S: disponibilidad

The ability of an *item* | o be in a state to perform a *required function* | t a given *instant of time* or at any *instant of time* within a given *time interval* , assuming that the external resources, if required, are provided.

Note 1 — This ability depends on the combined aspects of the *reliability performance* , the *maintainability performance* and the *maintenance support performance* of an *item* .

Note 2 — In the definition of the *item* | he external resources required must be delineated.

Note 3 — The term *availability* | s used as an *availability performance measure* .

Note 4 — Warning: the term *availability* has occasionally been used in connection with the term *item* , but with an implied meaning of *item* being entirely different from that of this Supplement.

4003 **reliability performance**

F: fiabilit´e

S: fiabilidad

The ability of an *item* | o perform a *required function* | nder given conditions for a given *time interval* .

Note 1 — It is generally assumed that the *item* | s in a state to perform this *required function* at the beginning of the *time interval* .

Note 2 — The term *reliability* | s used as a *measure* of *reliability performance* .

4004 **maintainability performance**

F: maintenabilit´e

S: mantenibilidad

The ability of an *item* | nder stated conditions of use, to be retained in, or restored to, a state in which it can perform a *required*

function , when *maintenance* is performed under given conditions and using stated procedures and resources.

Note — The term *maintainability* | s used as a *measure*
| f *maintainability performance* .

4005 **maintenance support performance**

F: logistique de maintenance

S: log´istica de mantenimiento

The ability of a maintenance organization, under given conditions, to provide upon demand the resources required to maintain an *item* , under a given *maintenance policy* .

Note — The given conditions are related to the *item* | tself and to the conditions under which the *item* is used and maintained.

4006 **durability**

F: durabilit´e

S: durabilidad

The ability of an *item* | o remain in a condition where it can perform a *required function* under stated conditions of use and *maintenance* until a limiting state is reached.

Note — A limiting state of an *item* | ay be characterized by the end of the *useful life* , unsuitability for any economic or technological reasons, etc.

5 Events and states

5.1 *Defects*

5101 **defect**

F: *d´efaut*

S: *defecto*

Any departure of a characteristic of an *item* | rom requirements.

Note 1 — The requirements may or may not be expressed in the form of a specification.

Note 2 — A defect may or may not affect the ability of an *item* | o perform a *required function* .

5102 **bug**

F: erreur de programmation; bogue

S: error de programación

A software *defect* | aused by a *mistake* .

5103 **critical defect**

F: défaut critique

S: defecto crítico

A *defect* | hat is assessed likely to result in injury to persons or significant material damage.

5104 **non-critical defect**

F: défaut non critique

S: defecto no crítico

A *defect* | ther than a *critical defect* .

5105 **major defect**

F: défaut majeur

S: defecto mayor

A *defect* | hat is likely to result in a *failure* | r to reduce materially the usability of the *item* for its intended purpose.

5106 **minor defect; imperfection**

F: défaut mineur; imperfection

S: defecto menor; imperfección

A defect other than a *major defect* .

5107 **defective; defective item**

F: défectueux; entité défectueuse

S: defectuoso; elemento defectuoso

An *item* | hich contains one or more *defects* .

5108 **critical defective item**

F: *d´efectueux critique*

S: *elemento defectuoso cr´itico*

An *item* **|** hich contains one or more *critical defect* .

5109 **major defective item**

F: *d´efectueux majeur*

S: *elemento defectuoso mayor*

An *item* **|** which contains one or more *major defects* .

5110 **minor defective item**

F: *d´efectueux mineur*

S: *elemento defectuoso menor*

An *item* **|** hich contains one or more *minor defects* **|** ut no *major defects* .

5111 **design defect**

F: d´efaut de conception

S: defecto de diseño

A *defect* | ue to an inadequate design of an *item* .

5112 **manufacturing defect**

F: d´efaut de fabrication

S: defecto de fabricaci´on

A *defect* | ue to nonconformance in manufacture to the design of an *item* or to specified manufacturing processes.

5.2 *Failures*

5201 **failure**

F: d´efaillance

S: fallo

The termination of the ability of an *item* | o perform a *required function* .

Note — After *failure* | he *item* | as a fault.

5202 **critical failure**

F: d´efaillance critique

S: fallo cr´itico

A *failure* | hich is assessed likely to result in injury to persons or significant material damage.

5203 **non-critical failure**

F: d´efaillance non critique

S: fallo no cr´itico

A *failure* | ther than a *critical failure* .

5204 **misuse failure**

F: d´efaillance par mauvaise utilisation

S: fallo por uso incorrecto

A *failure* | ue to induced stresses during use which are beyond the stated capabilities of the *item* .

5205 **mishandling failure**

F: d´efaillance par fausse manoeuvre

S: fallo por manejo incorrecto

A *failure* | aused by incorrect handling or lack of care of the *item*

5206 **(inherent) weakness failure**

F: d´efaillance par fragilit´e (inh´erente)

S: fallo por fragilidad (inherente)

A *failure* | ue to a weakness inherent in the *item* | tself when subjected to stresses within the stated capabilities of the *item*

5207 **design failure**

F: d´efaillance de conception

S: fallo de diseño

A *failure* | ue to a *design defect* .

5208 **manufacturing failure**

F: d´efaillance de fabrication

S: fallo de fabricaci´on

A *failure* | ue to a *manufacturing defect* .

5209 **ageing failure; wearout failure**

F: d´efaillance par vieillissement; d´efaillance par usure

S: fallo por envejecimiento; fallo por desgaste

A *failure* | hose probability of occurrence increases with the passage of time, as a result of processes inherent in the *item* .

5210 **sudden failure**

F: d´efaillance soudaine

S: fallo repentino

A *failure* | hat could not be anticipated by prior examination or monitoring.

5211 **gradual failure; degradation failure; drift failure**

F: d´efaillance progressive; d´egradation; d´efaillance par d´erive

S: fallo gradual; fallo por degradaci´on; fallo por deriva

A *failure* | ue to a gradual change in time of given characteristics of an *item* and that could be anticipated by prior examination or monitoring.

Note — A *gradual failure* | an sometimes be avoided by *preventive maintenance* .

5212 **cataleptic failure; catastrophic failure** (deprecated)

F: d´efaillance cataleptique

S: fallo catal´eptico; fallo catastr´ofico | (desaconsejado)

A *sudden failure* | hich results in a *complete fault* .

5213 **relevant failure**

F: d´efaillance pertinente; d´efaillance à prendre en compte

S: fallo pertinente; fallo relevante

A *failure* | o be included in interpreting test or operational results or in calculating the value of a *reliability performance measure* .

Note — The criteria for the inclusion should be stated.

5214 **non-relevant failure**

F: d´efaillance non pertinente; d´efaillance à ne pas prendre en compte

S: fallo no pertinente; fallo irrelevante

A *failure* | o be excluded in interpreting test or operational results or in calculating the value of a *reliability performance measure*

Note — The criteria for the exclusion should be stated.

5215 **primary failure**

F: d´efaillance primaire

S: fallo primario

A *failure* | f an *item* , not caused either directly or indirectly by the *failure* or the *fault* of another *item* .

5216 **secondary failure**

F: d´efaillance secondaire

S: fallo secundario

A *failure* | f an *item* , caused either directly or indirectly by the *failure* | r the *fault* of another *item* .

5217 **failure cause**

F: cause de d´efaillance

S: causa de fallo

The circumstances during design, manufacture or use which have led to a *failure* .

5218 **failure mechanism**

F: m´ecanisme de d´efaillance

S: mecanismo de fallo

The physical, chemical or other process which has led to a *failure* .

5219 **systematic failure; reproducible failure; deterministic failure**

F: d´efaillance syst´ematique; d´efaillance reproductible

S: fallo sistem´atico; fallo reproducible; fallo determin´istico

A *failure* | elated in a deterministic way to a certain cause, which can only be eliminated by a *modification* of the design or manufacturing process, operational procedures, documentation or other relevant factors.

Note 1 — *Corrective maintenance* | ithout *modification* will usually not eliminate the *failure cause* .

Note 2 — A *systematic failure* | an be induced at will by simulating the *failure cause* .

5.3 *Faults*

5301 **fault**

F: panne; d´erangement

S: *aver´ia*

The inability of an *item* | o perform a *required function* , excluding that inability due to *preventive maintenance* , lack of external resources or planned actions.

Note — A *fault* | s often the result of a *failure* | f the *item* itself, but may exist without prior *failure* .

5302 **critical fault**

F: *panne critique*

S: *aver´ia cr´itica*

A *fault* | hich is assessed likely to result in injury to persons or significant damage to material.

5303 **non-critical fault**

F: *panne non critique*

S: *aver´ia no cr´itica*

A *fault* , other than a *critical fault* .

5304 **major fault**

F: *panne majeure*

S: *aver´ia mayor*

A *fault* | hich affects a function considered to be of major importance.

5305 **minor fault**

F: *panne mineure*

S: *aver´ia menor*

A *fault* | ther than a *major fault* .

5306 **misuse fault**

F: *panne par mauvaise utilisation*

S: *aver´ia por uso incorrecto*

A *fault* | ue to induced stresses during use which are beyond the stated capabilities of the *item* .

5307 **mishandling fault**

F: *panne par fausse manoeuvre*

S: *aver´ia por manejo incorrecto*

A *fault* | aused by incorrect handling or lack of care of the *item* .

5308 **(inherent) weakness fault**

F: *panne par fragilit´e (inh´erente)*

S: *aver´ia por fragilidad (inherente)*

A *fault* | ue to a weakness inherent in the *item* | tself when subjected to stresses within the stated capabilities of the *item*

5309 **design fault**

F: *panne de conception*

S: *aver´ia de diseño*

A *fault* | ue to a *design defect* .

5310 **manufacturing fault**

F: *panne de fabrication*

S: *aver´ia de fabricaci´on*

A *fault* | ue to a *manufacturing defect* .

5311 **ageing fault; wearout fault**

F: *panne par vieillissement; panne par usure*

S: *aver´ia por envejecimiento; aver´ia por desgaste*

A *fault* | esulting from an *ageing failure* .

5312 **programme-sensitive fault**

F: panne mise en ´evidence par le programme

S: aver´ia dependiente del programa

A *fault* | hat is revealed as a result of the execution of some particular sequence of instructions.

5313 **data-sensitive fault**

F: panne mise en ´evidence par les donn´ees

S: aver´ia dependiente de los datos

A *fault* | hat is revealed as a result of the processing of a particular pattern of data.

5314 **complete fault; function preventing fault**

F: panne compl`ete

S: aver´ia completa

A *fault* | haracterized by complete inability to perform all *required functions* of an *item* .

Note — The criteria for a *complete fault* | ave to be stated.

5315 **partial fault**

F: panne partielle

S: aver´ia parcial

A *fault* | f an *item* | ther than a *complete fault* .

5316 **persistent fault; permanent fault; solid fault**

F: panne permanente

S: aver´ia permanente

A *fault* | f an *item* | hat persists until an action of *corrective maintenance* is performed.

5317 **intermittent fault; volatile fault; transient fault**

F: panne intermittente; panne temporaire

S: aver´ia intermitente; aver´ia transitoria

A fault of an *item* | hich persists for a limited *time duration*
| ollowing which the *item* recovers the ability to perform a *required*

function without being subjected to any action of *corrective maintenance*

Note — Such a *fault* is often recurrent.

5318 **determinate fault**

F: *panne franche*

S: *aver´ia clara; aver´ia determinable*

For an *item* , which produces a response as a result of an action, a *fault* for which the response is the same for all actions.

5319 **indeterminate fault**

F: *panne ind´etermin´ee*

S: *aver´ia indeterminable*

For an *item* , which produces a response as a result of an action, a *fault* such that the *error* affecting the response depends on the action applied.

Note — An example would be a *data-sensitive fault* .

5320 **latent fault**

F: panne latente

S: aver´ia latente

An existing *fault* | hat has not yet been recognized.

5321 **systematic fault**

F: panne syst´ematique

S: aver´ia sistem´atica

A *fault* | esulting from a *systematic failure* .

5322 **fault mode; failure mode** (deprecated)

F: mode de panne; mode de d´efaillance | (terme d´econseill´e)

S: modo de aver´ia; modo de fallo | (desaconsejado)

One of the possible states of a *faulty item* , for a given *required function* .

5323 **faulty**

F: en panne

S: averiado

Property of having a *fault* .

5.4 *Errors and mistakes*

5401 **error**

F: erreur

S: error

A discrepancy between a computed, observed or measured value or condition and the true, specified or theoretically correct value or condition.

Note — An *error* | an be caused by a *faulty item* , e.g. a computing *error* | ade by a *faulty* computer equipment.

5402 **execution error; generated error**

F: erreur d'ex´ecution

S: error de ejecuci´on

Error | roduced during the operation of a *faulty item* .

5403 **interaction error** (man-machine)

F: *erreur d'interaction* | (homme-machine)

S: *error de interacci´on* | (hombre-m´aquina)

An *error* | n the response of an *item* | aused by a *mistake* | uring its use.

5404 **propagated error**

F: *erreur propag´ee*

S: *error propagado*

An *error* | n the response to erroneous data input to a non-faulty *item* .

5405 **mistake; error** (deprecated in this sense)

F: *erreur (humaine); faute*

S: *equivocaci´on; error* | (desaconsejado en este sentido)

A human action that produces an unintended result.

5.5 *Item related states* | see also Figure 2)

Figure 2, p.

5501 **operating state**

F: (´etat de) fonctionnement

S: estado de funcionamiento; estado operacional

The state when an *item* | s performing a *required function* .

5502 **non-operating state**

F: (´etat de) non-fonctionnement

S: estado de no funcionamiento

The state when an *item* | s not performing a *required function* .

5503 **standby state**

F: (´etat d') attente

S: estado de espera (en reserva)

A non-operating *up state* | uring the *required time* .

5504 **idle state; free state**

F: ´etat vacant; ´etat libre

S: estado de reposo; estado libre

A non-operating *up state* | uring *non-required time* .

5505 **disabled state; outage**

F: ´etat d'incapicit´e

S: *estado de incapacidad*

A state of an *item* | haracterized by its inability to perform a *required function* , for any reason.

5506 **external disabled state**

F: *état d’incapacité externe*

S: *estado de incapacidad externa*

That subset of the *disabled state* | hen the *item* | s in an *up state* , but lacks required external resources.

5507 **down state; internal disabled state**

F: *´etat d'indisponibilit´e; ´etat d'incapacit´e interne*

S: *estado de indisponibilidad; estado de incapacidad interna*

A state of an *item* | haracterized by a *fault* | r by a possible inability to perform a *required function* during *preventive maintenance* .

Note — This state relates to *availability performance* .

5508 **up state**

F: *´etat de disponibilit´e*

S: *estado de disponibilidad*

A state of an *item* | haracterized by the fact that it can perform a *required function* , assuming that the external resources, if required, are provided.

Note — This state relates to *availability performance* .

5509 **busy state**

F: *´etat occup´e; occupation*

S: *estado de ocupaci´on; estado de ocupado*

The state of an *item* | n which it performs a *required function*
| or a user and for that reason is not accessible by other users.

5510 **critical state**

F: *´etat critique*

S: *estado cr´itico*

A state of an *item* | ssessed likely to result in injury to persons or significant material damage.

Note — A *critical state* | ay be the result of a *critical fault* , but not necessarily.

6 Maintenance

6001 **maintenance philosophy**

F: *philosophie de maintenance*

S: *filosof´ia de mantenimiento*

A system of underlying principles for the organization and execution of the *maintenance* .

6002 **maintenance policy**

F: *politique de maintenance*

S: *pol´itica de mantenimiento*

A description of the interrelationship between the *maintenance echelons* , the *indenture levels* and the *levels of maintenance* to be applied for the *maintenance* of an *item* .

6003 **maintenance**

F: *maintenance*

S: *mantenimiento*

The combination of all technical and corresponding administrative actions, including supervision actions, intended to retain an *item* in, or restore it to, a state in which it can perform a *required function* .

6004 **preventive maintenance**

F: maintenance pr´eventive; entretien

S: mantenimiento preventivo

The *maintenance* | arried out at predetermined intervals or according to prescribed criteria and intended to reduce the *probability* of *failure* or the degradation of the functioning of an *item* .

6005 **corrective maintenance; repair**

F: maintenance corrective; r´eparation; d´epannage

S: mantenimiento correctivo; reparaci´on

The *maintenance* | arried out after *fault recognition* | nd intended to restore an *item* to a state in which it can perform a *required function* .

6006 **deferred maintenance**

F: maintenance diff´er´ee

S: mantenimiento diferido

Such *corrective maintenance* | hich is not immediately initiated after a *fault recognition* but is delayed in accordance with given maintenance rules.

6007 **scheduled maintenance**

F: maintenance programm´ee; entretien syst´ematique

S: mantenimiento programado

The *preventive maintenance* | arried out in accordance with an established time schedule.

6008 **unscheduled maintenance**

F: maintenance non programm´ee

S: mantenimiento no programado

The *maintenance* | arried out, not in accordance with an established time schedule, but, for example, after reception of an indication regarding the state of an *item* .

6009 **on-site maintenance; in situ maintenance; field maintenance**

F: maintenance in situ

S: mantenimiento local; mantenimiento sobre el terreno

Maintenance | erformed at the premises where the *item* | s used.

6010 **off-site maintenance**

F: *maintenance déportée*

S: *mantenimiento no local*

Maintenance performed at a place different from where the *item* is used.

Note — An example is the *repair* of a sub-item at a maintenance centre.

6011 **remote maintenance**

F: *télémaintenance*

S: *mantenimiento remoto; telemantenimiento*

Maintenance of an *item* performed without physical access of the personnel to the *item* .

6012 **automatic maintenance**

F: *maintenance automatique*

S: *mantenimiento autom´atico*

Maintenance | ccomplished without human intervention.

6013 **function-affecting maintenance**

F: *maintenance affectant les fonctions*

S: *mantenimiento que afecta a la funci´on*

A *maintenance action* | hat affects one or more of the *required functions* of a maintained *item* .

Note — Function-affecting maintenance | s divided into *function-preventing maintenance* and *function-degrading maintenance* .

6014 **function-preventing maintenance**

F: *maintenance-arr | t; maintenance emp | chant l'accomplissement des fonctions*

S: *mantenimiento con discontinuidad de funciones*

A *maintenance action* | hat prevents a maintained *item* | rom performing a *required function* by causing complete loss of all the functions.

6015 **function-degrading maintenance**

F: *maintenance avec d´egradation; maintenance d´egradant les fonctions*

S: *mantenimiento con degradaci´on de funciones*

A *maintenance action* | hat affects one or more of the *required functions* | f a maintained *item* , but not to such extent as to cause complete loss of all the functions.

6016 **function-permitting maintenance**

F: *maintenance en fonctionnement; maintenance en exploitation*

S: *mantenimiento sin discontinuidad de funciones*

A *maintenance action* | hat does not affect any of the *required functions* | f a maintained *item* .

6017 **level of maintenance**

F: *niveau de maintenance*

S: *nivel de mantenimiento*

The *maintenance action* | o be carried out at a specified *indenture level* .

Note — Examples of a *maintenance action* | re replacing a component, a printed circuit board, a subsystem, etc.

6018 **maintenance echelon; line of maintenance**

F: échelon de maintenance

S: escalón de mantenimiento; línea de mantenimiento

The position in an organization where specified *levels of maintenance* | re to be carried out on an *item* .

Note 1 — Examples of *maintenance echelons* | re: field, repair shop, manufacturer.

Note 2 — The *maintenance echelon* | s characterized by the skill of the personnel, the facilities available, the location, etc.

6019 **indenture level** (for maintenance)

F: *niveau d'intervention* (pour la maintenance)

S: *nivel de intervenci´on* (para el mantenimiento)

A level of subdivision of an *item* | rom the point of view of a *maintenance action* .

Note 1 — Examples of *indenture levels* | ould be a subsystem, a circuit board, a component.

Note 2 — The *indenture level* | epends on the complexity of the item's construction, the accessibility to sub-items, skill level of maintenance personnel, test equipment facilities, safety considerations, etc.

6020 **elementary maintenance activity**

F: *op´eration ´el´ementaire de maintenance*

S: *acci´on elemental de mantenimiento*

The unit of work into which a maintenance activity may be broken down at a given *indenture level* .

6021 **maintenance action; maintenance task**

F: *op´eration de maintenance; t | che de maintenance*

S: *acci´on de mantenimiento; tarea de mantenimiento*

A sequence of *elementary maintenance activities* | arried out for a given purpose.

Note — Examples are *fault diagnosis* , *fault localization* | nd *function check-out* or combinations thereof.

6022 **supervision**

F: *surveillance; supervision*

S: *supervisi´on*

Activity, performed either manually or automatically, intended to observe the state of an *item* .

Note — Automatic *supervision* | ay be performed internally or externally to the *item* .

6023 **controlled maintenance**

F: *maintenance dirig´ee*

S: *mantenimiento dirigido*

A method to sustain a desired *quality of service* | y the systematic application of analysis techniques using centralized supervisory facilities and/or sampling to minimize *preventive maintenance* and to reduce *corrective maintenance* .

6024 **fault recognition**

F: *d´etection (de panne)*

S: *detecci´on (de una aver´ia*)

The event when a *fault* | s recognized.

6025 **fault diagnosis**

F: *diagnostic (de panne)*

S: *diagn´ostico (de una aver´ia)*

Actions taken for *fault recognition* , *fault localization* | nd cause identification.

6026 **fault localization; fault location** (deprecated in this sense)

F: *localisation de panne*

S: *localizaci´on* (de una aver´ia)

Actions taken to identify the *faulty* sub-item or sub-items at the appropriate *indenture level* .

6027 **fault correction**

F: *correction (de panne)*

S: *correcci´on (de una aver´ia)*

Actions taken after *fault localization* | ntended to restore the ability of the *faulty item* to perform a *required function* .

6028 **function check-out**

F: *v´erification (de fonctionnement)*

S: *verificaci´on de funcionamiento*

Actions taken after *fault correction* | o verify that the *item* | as recovered its ability to perform the *required function* .

6029 **restoration; recovery**

F: *r´etablissement*

S: *restablecimiento; restauraci´on*

That event when the *item* | egains the ability to perform a *required function* after a *fault* .

6030 **maintenance entity**

F: *cellule de maintenance*

S: *cellula de mantenimiento; entidad de mantenimiento*

A sub-item of a given *item* | efined with the intention that an alarm — caused by a *fault* in that sub-item — will be unambiguously referrable to the sub-item.

7 **Time concepts** (see also Figure 3)

7.1 *Maintenance related times*

7101 **maintenance time**

F: temps de maintenance

S: tiempo de mantenimiento

The *time interval* | uring which a *maintenance action* | s performed on an *item* either manually or automatically, including *technical delays* and *logistic delays* .

Note — *Maintenance* | ay be carried out while the *item* | s performing a *required function* .

7102 **maintenance man-hours (MMH)**

F: dur´ee ´equivalente de maintenance

S: duraci´on equivalente de mantenimiento; horas-hombre de mantenimiento

The accumulated durations of the *maintenance times* , expressed in hours, used by all maintenance personnel for a given type of *maintenance action* or over a given *time interval* .

Figure 3, p. 6

7103 **active maintenance time**

F: temps de maintenance active

S: tiempo de mantenimiento activo

That part of the *maintenance time* | uring which a *maintenance action* | s performed on an *item* , either automatically or manually, excluding *logistic delays* .

Note — Active maintenance may be carried out while the *item* | s performing a *required function* .

7104 **preventive maintenance time**

F: temps de maintenance pr´eventive

S: tiempo de mantenimiento preventivo

That part of the *maintenance time* | uring which *preventive maintenance* | s performed on an *item* , including *technical delays* and *logistic delays* inherent in *preventive maintenance* .

7105 **repair time; corrective maintenance time**

F: temps de r´eparation; temps de maintenance corrective

S: tiempo de reparaci´on; tiempo de mantenimiento correctivo

That part of the *maintenance time* | uring which *corrective maintenance* | s performed on an *item* , including *technical delays* and *logistic delays* inherent in *corrective maintenance* .

7106 **active preventive maintenance time**

F: temps de maintenance pr´eventive active

S: tiempo de mantenimiento preventivo activo

That part of the *active maintenance time* | uring which actions of *preventive maintenance* are performed on an *item* .

7107 **active repair time; active corrective maintenance time**

F: temps de r´eparation active; temps de maintenance corrective active

S: tiempo de reparaci´on activo; tiempo de mantenimiento correctivo activo

That part of the *active maintenance time* | uring which actions of *corrective maintenance* are performed on an *item* .

7108 **undetected fault time**

F: temps de non-d´etection de panne

S: tiempo de no detecci´on de una aver´ia

The *time interval* | etween a *failure* | nd recognition of the resulting *fault* .

7109 **administrative delay** (for corrective maintenance)

F: d´elai administratif (pour la maintenance corrective)

S: retardo administrativo (para el mantenimiento correctivo); *demora administrativa*

The *accumulated time* | uring which an action of *corrective maintenance* | n a *faulty item* is not performed due to administrative reasons.

7110 **logistic delay**

F: d´elai logistique

S: retardo log´istico; demora log´istica

That *accumulated time* | uring which a *maintenance action* | annot be performed due to the necessity to acquire *maintenance* resources, excluding any *administrative delay* .

Note — *Logistic delays* | an be due to, e.g. travelling to unattended installations, awaiting the arrival of spare parts, specialists or test equipment.

7111 **fault correction time**

F: temps de correction de panne

S: tiempo de correcci´on de una aver´ia

That part of *active repair time* | uring which *fault correction* | s performed.

7112 **technical delay**

F: d´elai technique

S: retardo t´ecnico; demora t´ecnica

The *accumulated time* | ecessary to perform auxiliary technical actions associated with the *maintenance action* itself.

7113 **check-out time**

F: temps de v´erification (du fonctionnement)

S: tiempo de verificaci´on (de funcionamiento)

That part of *active repair time* | uring which *function check-out* | s performed.

7114 **fault localization time; fault location time** (deprecated)

F: temps de localisation (de panne)

S: tiempo de localizaci´on de una aver´ia

That part of *active repair time* | uring which *fault localization* | s performed.

7.2 *Item-state related times*

7201 **operating time**

F: temps de fonctionnement

S: tiempo de funcionamiento

The *time interval* | uring which an *item* | s an *operating state* .

7202 **non-operating time**

F: temps de non-fonctionnement

S: tiempo de no funcionamiento

The *time interval* | uring which an *item* | s in a *non-operating state* .

7203 **required time**

F: p´eriode requise

S: periodo requerido

The *time interval* | uring which the user requires the *item* | o be in a condition to perform a *required function* .

7204 **non-required time**

F: p´eriode non requise

S: periodo no requerido

The *time interval* | uring which the user does not require the *item* | o be in a condition to perform a *required function* .

7205 **stand-by time**

F: p´eriode d’attente

S: tiempo de espera (en reserva)

The *time interval* | uring which an *item* | s in a *stand-by state* .

7206 **idle time; free time**

F: p´eriode vacante; temps mort; temps libre

S: tiempo de reposo; tiempo muerto; tiempo libre

The *time interval* | uring which an *item* | s in a *free state* .

7207 **disabled time**

F: temps d’incapacit´e

S: tiempo de incapacidad

The *time interval* | uring which an *item* | s in a *disabled state* .

7208 **down time**

F: temps d’indisponibilit´e

S: tiempo de indisponibilidad

The *time interval* | uring which an *item* | s in a *down state* .

7209 **accumulated down time**

F: dur´ee cumul´ee d’indisponibilit´e

S: tiempo de indisponibilidad acumulado

The sum of the duration of *down times* | ver a given *time interval* .

7210 **external disabled time; external loss time**

F: temps d’incapacit´e externe

S: tiempo de incapacidad externa

The *time interval* | uring which an *item* | s in an *external disabled state* .

7211 **up time**

F: temps de disponibilit´e; temps de bon fonctionnement

S: tiempo de disponibilidad

The *time interval* | uring which an *item* | s in an *up state* .

7.3 *Time concepts related to reliability performance*

7301 **time to first failure**

F: dur´ee de fonctionnement avant la premi`ere d´efaillance

S: tiempo hasta el primer fallo

Total *time duration* | f the *operating time* | f an *item* | rom the *instant of time* it is first put in an *up state* , until *failure* .

7302 **time to failure**

F: dur´ee de fonctionnement avant d´efaillance

S: tiempo hasta el fallo

Total *time duration* | f the *operating time* | f an *item* , from the *instant of time* it goes from a *down state* to an *up state* , after a corrective *maintenance action* , until the next *failure* .

7303 **time between failures**

F: temps entre d´efaillances

S: tiempo entre fallos

The *time duration* | etween two successive *failures* | f a *repaired item* .

Note 1 — Those parts of *non-operating time* | hich are included must be identified.

Note 2 — In some applications only the *up time* | s considered.

7304 **time to restoration; time to recovery**

F: temps de panne

S: tiempo de aver´ia

The *time interval* | uring which an *item* | s in a *down state* | ue to a *failure* .

7305 **useful life**

F: (dur´ee de) vie utile

S: vida ´util

Under given conditions, the *time interval* | eginning at a given *instant of time* , and ending when the *failure intensity* becomes unacceptable or when the *item* is considered unrepairable as a result of a *fault* .

7306 **early failure period**

F: p´eriode initiale de d´efaillance

S: periodo de fallos inicial

That possible early period in the life of an *item* , beginning at a given *instant of time* and during which the *instantaneous failure intensity* for a *repaired item* or the *instantaneous failure rate* for a *non-repaired item* decreases rapidly.

Note — In any particular case, it is necessary to explain what is meant by ‘‘decreases rapidly’’.

7307 **constant failure intensity period**

F: p´eriode d'intensit´e constante de d´efaillance

S: periodo de intensidad de fallos constante

That possible period in the life of a *repaired item* | uring which the *failure intensity* is approximately constant.

Note — In any particular case it is necessary to explain what is meant by ‘‘approximately constant’’.

7308 **constant failure rate period**

F: p´eriode de densit´e constante de d´efaillance; p´eriode de taux constant de d´efaillance

S: periodo de tasa de fallos constante

That possible period in the life of a *non-repaired item* | uring which the *failure rate* is approximately constant.

Note — In any particular case it is necessary to explain what is meant by ‘‘approximately constant’’.

7309 **wear-out failure period**

F: p´eriode de d´efaillance par vieillissement; p´eriode de d´efaillance par usure

S: periodo de fallos por envejecimiento

That possible later period in the life of an *item*
| uring which the *instantaneous failure intensity* for a *repaired item* or the *instantaneous failure rate* for a *non-repaired item* increases rapidly.

Note — In any particular case it is necessary to explain what is meant by ‘‘increases rapidly’’.

8 Measures of performances

8.1 *Availability performance*

8101 **instantaneous availability; pointwise availability; A(t)** (symbol)

F: disponibilit´e (instantan´ee), A(t) | symbole)

S: disponibilidad instant´anea, A(t) | s´imbolo)

The *probability* | hat an *item* | s in an *up state* | t a given *instant of time* , *t* .

Note — In French the term *disponibilit´e* | s also used to denote the performance quantified by this *probability* .

8102 **instantaneous unavailability; pointwise unavailability; U(t)** (symbol)

F: indisponibilit´e (instantan´ee), U(t) | symbole)

S: indisponibilidad instant´anea, U(t) | s´imbolo)

The probability that an *item* | s in a *down state* | t a given *instant of time* , *t* .

8103 **mean availability, A (t↓1, | ↓2)** (symbol)

F: disponibilit´e moyenne, A | (t_1, t_2) (symbole)

S: disponibilidad media, A | (t_1, t_2) (s´imbolo)

The normalized integral of the *instantaneous availability* | n a given *time interval* (t_1, t_2).

Note — The *mean availability* | s related to the *instantaneous availability* as

A | *fR* (*t* 1
, *t* 2) =
[Formula Deleted]
f It ∫ 2
t 1
A (*t*) d*t* .

8104 **mean unavailability, U (t↓1, t↓2)** (symbol)

F: indisponibilit´e moyenne, U | (t_1, | fIt$_2$) (symbole)

S: indisponibilidad media, U | (t_1, | fIt$_2$) (s´imbolo)

The normalized integral of the *instantaneous unavailability* | n a stated *time interval* (t_1, | fIt$_2$).

Note — The *mean unavailability* | s related to the *instantaneous unavailability* as

$$U \mid fR(t_1, t_2) =$$

[Formula Deleted]

$$\text{f I} \int_{t_1}^{t_2} U(t)\,\mathrm{d}t .$$

8105 **(asymptotic) availability; (steady-state) availability; A** (symbol)

F: disponibilit´e asymptotique; disponibilit´e, A
| symbole)

S: disponibilidad (asint´otica); disponibilidad (en r´egimen permanente); A | s´imbolo)

The limit, if this exists, of the *instantaneous availability*
| hen the time tends to infinity.

Note — Under certain conditions, for instance constant failure rate and constant repair rate, the *asymptotic availability* may be expressed as:

$$A = \frac{\text{f IMUT}}{f\,IMUT + MDT}$$

where

MDT | s the *mean down time*

MUT | s the *mean up time* .

8106 **asymptotic unavailability, U** (symbol)

F: *indisponibilit´e asymptotique, U* | symbole)

S: *indisponibilidad asint´otica, U* | s´imbolo)

The limit, if this exists, of the *instantaneous unavailability* | hen the time tends to infinity.

Note — Under certain conditions, for instance constant failure rate and constant repair rate, the *asymptotic unavailability* may be expressed as:

$$U = \frac{f\,IMDT}{f\,IMDT + MUT}$$

where

MDT | s the *mean down time*

MUT | s the *mean up time* .

8107 **asymptotic mean availability, A** (symbol)

F: *disponibilit´e moyenne asymptotique, A* | (symbole)

S: *disponibilidad media asint´otica, A* | (s´imbolo)

The limit, if this exists, of the *mean availability* | ver a *time interval* (t_1, | fIt$_2$) when $t_2$tends to infinity.

Note 1 — The *asymptotic mean availability* | s related to the *mean availability* as

$A \mid fR = lim\ \ A \mid fR\ (t_1, t_2)$

$A \mid fR = t_2\ \infty$

Note 2 — When such a limit exists it is not dependent on t_1.

8108 **asymptotic mean unavailability, U** (symbol)

F: *indisponibilit´e moyenne asymptotique, U* | (symbole)

S: *indisponibilidad media asint´otica , U* | (s´imbolo)

The limit, if this exists, of the *mean unavailability* | ver a *time interval* | t_1, | fIt$_2$) when $t_2$tends to infinity.

Note 1 — The *asymptotic mean unavailability* | s related to the *mean unavailability* | s

$U \mid fR = lim\ \ U \mid fR\ (t_1, t_2)$

$U \mid fR = t_2\ \infty$

Note 2 — When such a limit exists it is not dependent on t_1.

8109 **mean up time (MUT)**

F: temps moyen de disponibilit´e; dur´ee moyenne de disponibilit´e (TMD)

S: tiempo medio de disponibilidad (TMD)

The *expectation* **|** f the *up time* .

8110 **mean accumulated down time (MADT)**

F: dur´ee cumul´ee moyenne d'indisponibilit´e

S: tiempo medio acumulado de indisponibilidad (TMAI)

The *expectation* **|** f the *accumulated down time* .

8111 **instantaneous availability of a leased circuit**

F: disponibilit´e instantan´ee d'un circuit lou´e

S: disponibilidad instant´anea de un circuito arrendado

The *probability* | hat, under stated operating conditions, a leased circuit can perform a *required function* when requested by the subscriber.

8.2 *Reliability performance*

8201 **reliability, R** (symbol)

F: fiabilit´e, R | symbole)

S: fiabilidad, R | s´imbolo)

The *probability* | hat an *item* | an perform a *required function* | nder stated conditions for a given *time interval* .

Note 1 — It is generally assumed that the *item* | s in a state to perform this *required function* at the beginning of the *time interval* .

Note 2 — In French, the term *fiabilit´e* | s also used to denote the performance quantified by this *probability* .

8202 **(instantaneous) failure rate, λ(t)** (symbol)

F: densit´e (temporelle) (instantan´ee) de d´efaillance; taux (instantan´e) de d´efaillance, λ(t) | (symbole)

S: tasa (instant´anea) de fallos, λ(t) | s´imbolo)

The limit, if this exists, of the ratio of the conditional *probability* | hat the *time to failure* , *T* , of an *item* falls within a given *time interval* , (*t* , | fIt +?63*t*), to the length of this interval, ?63*t* , when ?63*t* tends to zero, given that the *item* is in a state to perform a *required function* at the beginning of the *time interval* .

Note — The *instantaneous failure rate* | s expressed by formula as:

$$\lambda(t) = \lim \lambda(t) = ?63\,(t)\ 0+ \frac{\mathrm{f\,IPr}\,(t < T\ t + ?\,63\ t \mid T > t)}{63t}$$

where *T* | s the *instant of time* | f *failure* .

The formula is also applicable if *T* | enotes the *time to failure* .

8203 **mean failure rate, λ (t↓1, | ↓2)** (symbol)

F: taux moyen de d´efaillance; densit´e (temporelle) moyenne de d´efaillance, λ | (t_1, | fIt_2) (symbole)

S: tasa media de fallos, λ | (t_1, | fIt_2) (s´imbolo)

The normalized integral of the *instantaneous failure rate* | ver a given *time interval* , (t_1, | fIt_2).

Note — The *mean failure rate* | elates to *instantaneous failure rate* as

$$\lambda(t_1, t_2) =$$

[Formula Deleted]

$$\text{f It} \int_{t_1}^{2} \lambda(t)\,dt .$$

8204 **(instantaneous) failure intensity, z(t)** (symbol)

F: intensit´e (instantan´ee) de d´efaillance, z(t)
| (symbole)

S: intensitad (instant´anea) de fallos, z(t) | (s´imbolo)

The limit, if this exists, of the ratio of the mean number of *failures* | f a *repaired item* in a *time interval* , (*t* , | fIt |
| 63*t*), to the length of this interval, ?63*t* , when the length of the *time interval* tends to zero.

Note — The *instantaneous failure intensity* | s expressed by formula as:

$$z(t) = \lim z(t) = ?63t\ 0+ \frac{\text{f IE } [N(t + ?63t) — N(t)]}{63t}$$

where N | t) is the number of *failures* | n the *time interval* | (0, | fIt).

8205 **mean failure intensity, z (t↓1, | ↓2)** (symbol)

F: *intensit´e moyenne de d´efaillance, z* | (t_1, | fIt$_2$) (symbole)

S: *intensidad media de fallos, z* | (t_1, | fIt$_2$) (s´imbolo)

The normalized integral of the *instantaneous failure intensity* | over a given *time interval* | (t_1, | fIt$_2$).

Note — The *mean failure intensity* | s related to *instantaneous failure intensity* as:

z | fR (t_1, t_2) =

[Formula Deleted]

$$\int_{t_1}^{\text{f It } 2} z(t)\,dt \,.$$

8206 **mean time to first failure (MTTFF)**

F: dur´ee moyenne de fonctionnement avant la premi`ere d´efaillance (MTTFF)

S: *tiempo medio hasta el primer fallo (MTTFF)*

The *expectation* | f the *time to first failure* .

8207 **mean time to failure (MTTF)**

F: *dur´ee moyenne de fonctionnement avant d´efaillance (MTTF)*

S: *tiempo medio hasta el fallo (MTTF)*

The *expectation* | f the *time to failure* .

8208 **mean time between failures (MTBF)**

F: *moyenne des temps entre d´efaillances (MTBF)*

S: *tiempo medio entre fallos (MTBF)*

The *expectation* | f the *time between failures* .

8209 **failure rate acceleration factor**

F: facteur d'acc´el´eration de la densit´e de d´efaillance; facteur d'acc´el´eration du taux de d´efaillance

S: factor de aceleraci´on de la tasa de fallos

The ratio of the accelerated testing *failure rate* | o the *failure rate* under stated reference test conditions.

Note — Both *failure rates* | efer to the same time period in the life of the tested *items* .

8210 **failure intensity acceleration factor**

F: facteur d'acc´el´eration de l'intensit´e de d´efaillance

S: factor de aceleraci´on de la intensidad de fallos

In a *time interval* | f given *duration* , whose beginning is specified by a fixed age of a *repaired item* , the ratio of the number of *failures* obtained under two different sets of stress conditions.

8.3 *Maintainability performance*

8301 **maintainability**

F: maintenabilit´e

S: mantenibilidad

The *probability* | hat a given active *maintenance action* , for an *item* | nder given conditions of use can be carried out within a stated *time interval* , when the *maintenance* is performed under stated conditions and using stated procedures and resources.

Note — In French the term *maintenabilit´e* | s also to denote the performance quantified by this *probability* .

8302 **(instantaneous) repair rate, μ(t)** (symbol)

F: densit´e (temporelle) (instantan´ee), de r´eparation, μ *(t)* | symbole)

S: tasa (instant´anea) de reparaciones, μ*(t)* | s´imbolo)

The limit, if this exists, of the ratio of the conditional *probability* | hat the corrective *maintenance action* terminates in a *time interval* , (*t* , *t* +?63*t*) to the length of this *time interval* , when ?63*t* tends to zero, given that the action had not terminated at the beginning of the *time interval* .

Note — The *instantaneous repair rate* | s expressed by formula as:

μ (*t*) = lim μ (*t*) = ?63 (*t*) 0 $\frac{\text{f IPr}(t < T\ t + ?63\ t \mid T > t)}{63t}$

where *T* | is the *instant of time* | f *restoration* .

T | ay also represent the *time to restoration* .

8303 **mean repair rate, μ (t↓1, | ↓2)** (symbol)

F: densit´e (temporelle) moyenne de r´eparation, μ | *fR (t*$_1$, | fIt$_2$) (symbole)

S: tasa media de reparaciones, μ | *fR (t*$_1$, | fIt$_2$) (s´imbolo)

The normalized integral of the *instantaneous repair rate* | ver a given *time interval* (*t*$_1$, | fIt$_2$).

Note — The *mean repair rate* | s related to *instantaneous repair rate* as:

μ (*t*$_1$, *t*$_2$) =

[Formula Deleted]

$\text{f It}\int_{t_1}^{2} \mu (t)\, dt$.

8304 **mean maintenance man-hours**

F: dur´ee moyenne ´equivalente de maintenance

S: duraci´on media equivalente de mantenimiento; media de horas-hombre de mantenimiento

The *expectation* **|** f the *maintenance man-hours* .

8305 **mean down time (MDT)**

F: temps moyen d'indisponibilit´e; dur´ee moyenne d'indisponibilit´e (TMI)

S: tiempo medio de indisponibilidad (TMI)

The *expectation* **|** f the *down time* .

8306 **mean repair time (MRT)**

F: dur´ee moyenne de r´eparation

S: tiempo medio de reparaci´on

The *expectation* **|** f the *repair time* .

8307 **p-fractile repair time**

F: quantile-p de la dur´ee de r´eparation

S: cuantil-p del tiempo de reparaci´on

The *p-fractile* | alue of the *repair time* .

8308 **mean active repair time (MART)**

F: dur´ee moyenne de r´eparation active

S: tiempo medio de reparaci´on activa

The *expectation* | f the *active repair time* .

8309 **p-fractile active repair time**

F: quantile-p de la dur´ee de r´eparation active

S: cuantil-p del tiempo de reparaci´on activa

The *p-fractile* | alue of the *active repair time* .

8310 **mean time to restoration (MTTR); mean time to recovery; mean time to repair** (deprecated)

F: dur´ee moyenne de panne; moyenne des temps pour la t | che de r´eparation (MTTR)

S: tiempo medio hasta el restablecimiento (MTTR)

The *expectation* | f the *time to restoration* .

8311 **fault coverage**

F: couverture de pannes

S: cobertura de aver´ias

The proportion of *faults* | f an *item* | hat can be recognized under given conditions.

8312 **repair coverage**

F: couverture des r´eparations

S: cobertura de reparaciones

The proportion of *faults* | f an *item* | hat can be successfully removed.

8.4 *Maintenance support performance*

8401 **mean administrative delay (MAD)**

F: dur´ee moyenne du d´elai administratif

S: retardo medio administrativo; demora media administrativa

The *expectation* | f the *administrative delay* .

8402 **p-fractile administrative delay**

F: quantile-p du d´elai administratif

S: cuantil-p del retardo administrativo; cuantil-p de la demora administrativa

The *p-fractile* | alue of the *administrative delay* .

8403 **mean logistic delay (MLD)**

F: dur´ee moyenne du d´elai logistique

S: retardo medio log´istico; demora media log´istica

The *expectation* | f the *logistic delay* .

8404 **p-fractile logistic delay**

F: quantile-p du d´elai logistique

S: cuantil-p del retardo log´istico; cuantil-p de la demora log´istica

The *p-fractile* | alue of the *logistic delay* .

9 Test, data, design and analysis

9.1 *Test concepts*

9101 **test**

F: essai

S: prueba

An experiment made in order to measure or classify a *characteristic* .

9102 **compliance test**

F: essai de conformit´e

S: prueba de conformidad

A *test* | sed to show whether or not a *characteristic* | f an *item* | omplies with the stated requirements.

9103 **determination test**

F: essai de d´etermination

S: prueba de determinaci´on

A *test* | sed to establish the value of a *characteristic* .

9104 **laboratory test**

F: essai en laboratoire

S: prueba de laboratorio

A *compliance test* | r a *determination test* | ade under prescribed and controlled conditions which may or may not simulate field conditions.

9105 **field test**

F: *essai dans des conditions d'exploitation*

S: *prueba en condiciones de explotación; prueba en condiciones reales*

A *compliance test* | r *determination test* | ade in the field where operating, environmental, maintenance and measurement conditions are recorded.

9106 **endurance test**

F: *essai d'endurance*

S: *prueba de resistencia*

A *test* | arried out over a *time interval* | o investigate how the properties of an *item* are affected by the application of stated stresses and by their *time duration* .

9107 **accelerated test**

F: *essai accéléré*

S: *prueba acelerada*

A *test* | n which the applied stress level is chosen to exceed that stated in the reference conditions in order to shorten the *time duration* required to observe the stress response of the *item* , or to magnify the responses in a given *time duration* .

Note — To be valid, an *accelerated test* | hall not alter the basic *fault modes* and *failure mechanisms* , or their relative prevalence.

9108 **step stress test**

F: *essai sous contrainte ´echelonn´ee*

S: *prueba de esfuerzo escalonado*

A *test* | onsisting of several stress levels applied sequentially for periods of equal *time duration* | o an *item* , in such a way that during each *time interval* a stated stress level is applied and the stress level is increased from one *time interval* to the next.

9109 **screening test**

F: *essai de s´election*

S: *prueba de selecci´on*

A *test* , or combination of *tests* , intended to remove or detect unsatisfactory *items* | r those likely to exhibit early *failures* .

9110 **time acceleration factor**

F: *facteur d'acc´el´eration temporelle*

S: *factor de aceleraci´on temporal*

The ratio between the *time durations* | ecessary to obtain the same stated number of *failures* | r degradations in two equal size samples under two different sets of stress conditions involving the same *failure mechanisms* and *fault modes* and their relative prevalence.

Note — One of the two sets of stress conditions should be a reference set.

9111 **maintainability verification**

F: *v´erification de la maintenabilit´e*

S: *verificaci´on de la mantenibilidad*

A procedure applied for the purpose of determining whether the requirements for *maintainability performance measures* for an *item* has been achieved or not.

Note — The procedures may range from analysis of appropriate data to a *maintainability demonstration* .

9112 **maintainability demonstration**

F: *v´erification exp´erimentale de maintenabilit´e*

S: *demostraci´on de la mantenibilidad*

A *maintainability verification* | erformed as a *compliance test* .

9.2 *Data concepts*

9201 **observed data**

F: valeur observ´ee; donn´ee observ´ee

S: datos observados; valores observados

Values related to an *item* | r a process obtained by direct observation.

Note — Values referred to could be events, *time instants*, *time intervals* , etc.

9202 **test data**

F: donn´ees d'essai

S: datos de prueba

Observed data | btained during *tests* .

9203 **field data**

F: donn´ee d'exploitation

S: datos de explotaci´on

Observed data | btained during field operation.

9204 **reference data**

F: valeur de r´ef´erence; donn´ees de r´ef´erence

S: datos de referencia; valores de referencia

Data, which by general agreement may be used for *prediction* | nd/or comparison with *observed data* .

9.3 *Design concepts*

9301 **redundancy**

F: redondance

S: redundancia

In an *item* , the existence of more than one means for performing a *required function* .

9302 **active redundancy**

F: redondance active

S: redundancia activa

That *redundancy* | herein all means for performing a *required function* | re intended to operate simultaneously.

9303 **standby redundancy**

F: redondance en attente; redondance passive; redondance en secours

S: redundancia pasiva; redundancia de reserva

That *redundancy* | herein one means for performing a *required function* | s intended to operate, while the alternative means are inoperative until needed.

9304 **fail safe**

F: prot´eg´e contre d´efaillances (critique); à s | ret´e int´egr´ee

S: prevenci´on de fallos

A designed property of an *item* | hich prevents its *failures* | rom resulting in *critical faults* .

9305 **fault tolerance**

F: tol´erance aux pannes

S: tolerancia a las aver´ias

The attribute of an *item* | hat makes it able to perform a *required function* | n the presence of certain given sub-item *faults* .

9306 **fault masking**

F: masquage de panne

S: enmascaramiento de aver´ia

The condition in which a *fault* | xists in a sub-item of an *item* | ut cannot be recognized because of a feature of the *item* or because of another *fault* of the sub-item or of another sub-item.

9.4 *Analysis concepts*

9401 **prediction**

F: pr´evision; pr´ediction

S: previsi´on; predicci´on

1) The process of computation used to obtain (a) *predicted* | alue(s) of a quantity.

2) The *predicted* | alue(s) of a quantity.

9402 **reliability model**

F: mod`ele de fiabilit´e

S: modelo de fiabilidad

A mathematical model used for *prediction* | r *estimation* | f *reliability measures* | f an *item* or for similar purposes.

9403 **fault modes and effects analysis (FMEA)**

F: analyse des modes de panne et de leurs effets (AMDE)

S: an´alisis de los modos de aver´ia y de sus efectos (AMAE)

A qualitative method of *reliability* | nalysis which involves the study of the *fault modes* | hich can exist in every sub-item of the *item* and the determination of the effects of each *fault mode* on other sub-items of the *item* and on the *required functions* of the *item* .

9404 **fault modes, effects and criticality analysis (FMECA)**

F: analyse des modes de panne, de leurs effets et de leur criticit´e (AMDEC)

S: an´alisis de los modos de aver´ia, sus efectos y su criticidad (AMAEC)

Fault modes and effect analysis | ogether with a consideration of the *probability* | f occurrence and a ranking of the seriousness of the *fault* .

9405 **fault tree analysis (FTA)**

F: analyse par arbre de panne

S: an´alisis en ´arbol de aver´ias

An analysis to determine which *fault modes* | f the sub-items or external events, or combinations thereof, may result in a stated *fault mode* of the *item* , resulting in a *fault tree* .

9406 **stress analysis**

F: analyse de contraintes

S: an´alisis de esfuerzos

A quantitative or qualitative determination of the physical, chemical or other stresses an *item* | s subjected to under given use conditions.

9407 **reliability block diagram**

F: diagramme de fiabilit´e

S: diagrama de bloques de fiabilidad

Block diagram showing, for one or more *functional modes* | f a complex *item* , how *faults* | f the sub-items represented by the blocks, or combinations thereof, result in a *fault* of the *item* .

9408 **fault tree**

F: arbre de panne

S: ´arbol de aver´ias

A logic diagram showing which *fault modes* | f sub-items or external events, or combinations thereof, result in a given *fault mode* of the *item* .

9409 **state-transition diagram**

F: diagramme de transition

S: diagrama de transici´on de estados

A diagram showing the set of possible states of an *item* | nd the possible one step transitions between these states.

9410 **stress model**

F: mod`ele de contraintes

S: modelo de esfuerzos

A mathematical model which describes how a *reliability performance measure* | f an *item* | aries as a function of the applied stresses.

9411 **fault analysis**

F: analyse des pannes

S: an´alisis de aver´ias

The logical, systematic examination of an *item* | r its diagram(s) to identify and analyse the *probability* , causes and consequences of potential and real *faults* .

9412 **maintainability model**

F: mod`ele de maintenabilit´e

S: modelo de mantenibilidad

A mathematical model used for *prediction* | r *estimation* | f *maintainability performance measures* of an *item* or for similar purposes.

Note — An example is the *maintenance tree* .

9413 **maintainability prediction**

F: pr´evision de maintenabilit´e; pr´ediction de maintenabilit´e

S: previsi´on de la mantenibilidad; predicci´on de la mantenibilidad

An activity performed with the intention to forecast the numerical values of a *maintainability performance measure* of an *item* , taking into account the *maintainability performance* and *reliability performance measures* of its sub-items, under given operational and maintenance conditions.

9414 **maintenance tree**

F: arbre de maintenance

S: ´arbol de mantenimiento

A logic diagram showing the pertinent alternative sequences of *elementary maintenance activities* | o be performed on an *item* and the conditions for their choice.

9415 **maintainability allocation; maintainability apportionment**

F: r´epartition de la maintenabilit´e

S: distribuci´on de la mantenibilidad; asignaci´on de la mantenibilidad

A procedure applied during the design of an *item* | ntended to apportion the requirements for *maintainability performance measures* for an *item* to its sub-items according to given criteria.

9.5 *Improvement processes*

9501 **learning process**

F: apprentissage

S: aprendizaje

Growth in experience and familiarity by personnel with design or constructional techniques, which reduces the risk of future *mistakes* .

9502 **burn-in**

F: rodage

S: rodaje

A process of *reliability improvement* | f hardware, employing operation of every *item* | n a prescribed environment, with successive *fault correction* , replacement or removal at every *failure* , during the steeply falling *failure intensity* period within the *early failure period* .

9503 **reliability growth**

F: croissance de la fiabilit´e

S: crecimiento de la fiabilidad; incremento de la fiabilidad

A condition characterized by a progressive improvement of a *reliability performance measure* | f an *item* , or population of similar *items* , with time.

Note — A growth can result either from active improvement or from *burn-in* .

9504 **reliability improvement**

F: am´elioration de fiabilit´e

S: mejora de la fiabilidad

A process undertaken with the deliberate intention of promoting *reliability growth* | y the elimination of *systematic faults* .

9505 **maintainability programme**

F: programme de maintenabilit´e

S: programa de mantenibilidad

A detailed plan, including the human and material resources, procedures, tasks and responsibilities during the life of an *item* , intended to determine the fulfilment of the requirements for *maintainability performance measures* for an *item* and facilitate the planning of the *maintenance* .

10 Measure modifiers

1001 **true | ..**

F: ... | *rai*

S: ... | *erdadero*

The ideal value which characterizes a quantity perfectly defined under the conditions which exist at the moment when that quantity is observed, or the subject of a determination.

Note — This value could be arrived at only if all causes of measurement *error* were eliminated.

1002 **predicted | ..**

F: ... | *r´edit; ... | r´evu*

S: ... | *revisto; ... | redicho*

The numerical value assigned to a quantity, before the quantity is actually observable, computed on the basis of earlier observed or estimated values of the same quantity or of other quantities using a mathematical model.

1003 **extrapolated | ..**

F: ... | *xtrapol´e*

S: ... | *xtrapolado*

The *predicted* | alue based on *estimated* | alues for one or a set of conditions, intended to apply to other conditions such as time, *maintenance* and environmental conditions.

1004 **estimated | ..**

F: ... | *stim´e*

S: ... | *stimado*

The value obtained as the result of an *estimation* .

Note — The result may be expressed either as a single numerical value, a point estimate, or as a *confidence interval* .

1005 **intrinsic | ..; inherent | ..**

F: ... | *ntrins`eque; ... | nh´erent*

S: ... | *ntr´inseco; ... | nherente*

Value of a *measure* | etermined when maintenance and operational conditions are assumed to be ideal.

1006 **operational | ..**

F: ... | *p´erationnel*

S: ... | *peracional*

Value determined under given operational conditions.

1007 **mean | ..; average | ..** (deprecated)

F: ... | *oyen (adjectif)*

S: ... | *edio (adjetivo); promedio* | desaconsejado)

1) The value obtained as the *expectation* | f a *random variable* .

2) The normalized integral of a time dependant quantity.

1008 **p-fractile | ..**

F: ... | *uantile-p*

S: *cuantil-p de* | ..

The value obtained as the *p-fractile* | f the distribution of a *random variable* .

1009 **instantaneous | ..**

F: ... | nstantan´e

S: ... | *nstant´aneo*

The value of a *measure* | etermined for a given *instant of time* .

PART II

Statistical vocabulary

1 Introduction

The quantitative applications of measures for quality of service, network performance, dependability and trafficability performance requires a fundamental set of statistical concepts.

This Part provides the terms and definitions for such applications.

2 Terms and definitions

2001 **characteristic**

F: caract`ere (statistique)

S: caracter´istica

A property which helps to differentiate between the individuals of a given population.

Note — The differentiation may be either quantitative (by variables) or qualitative (by attributes).

2002 **probability**

F: probabilit´e

S: probabilidad

For practical reasons, it may be considered that, whenever the conditions of a *test* | an be reproduced, the *probability Pr (E)* | of an event *E* | ccurring is the value around which the occurrence frequency of the latter oscillates and towards which it tends when the number of tests are indefinitely increased.

Note — The concept of *probability* | ay be introduced in either of two forms, depending on whether it is intended to designate a degree of belief or whether it is considered as the limit value of a frequency. In both cases, its introduction requires that some precautions be taken which cannot be developed within the context of an International Standard and for which users should refer to specialized literature.

2003 **random variable; variate**

F: variable al´eatoire

S: variable aleatoria

A variable which may take any of the values of a specified set of values and with which is associated a probability distribution.

Note — A *random variable* | hich may take only isolated values is said to be ‘‘discrete’’. A *random variable* | hich may take all the values of a finite or infinite interval is said to be ‘‘continuous’’.

2004 **random process**

F: *processus aléatoire; processus stochastique*

S: *proceso aleatorio; proceso estocástico*

A collection of time-dependent *random variables* | here the values are governed by a given set of multivariate distributions for all combinations of the *random variables* .

2005 **distribution function**

F: *fonction de répartition*

S: *función de distribución*

A function giving, for every value x , the *probability* | hat the *random variable* X | s less than or equal to x :

$$F(x) = Pr(X \quad x).$$

2006 **probability density function**

F: *densit´e de probabilit´e*

S: *funci´on densidad de probabilidad*

The derivative, if this exists, of the *distribution function* :

$$f(x) = \frac{F(x)}{X} .$$

2007 **p-fractile; p-quantile** (of a probability distribution)

F: *quantile d'ordre p; quantile-p* (d'une loi de probabilit´e)

S: *cuantil-p; cuantil de orden p* (de una ley de distribuci´on de probabilidades)

If p | s a number between 0 and 1, the *p-fractile* | s the value of the *random variable* | or which the *distribution function* equals p or ''jumps'' from a value less than or equal to p to a value greater than p .

Note — It is possible that the *distribution function* | quals p throughout the interval between consecutive possible values of the variate. In this case, any value in this interval may be considered as the *p-fractile* .

2008 **expectation** (of a random variable)**; mean** (of a random variable)

F: *esp´erance math´ematique* (d'une variable al´eatoire); *moyenne* (d'une variable al´eatoire)

S: *esperanza matem´atica* (de una variable aleatoria); *media* (de una variable aleatoria)

a) For a discrete *random variable* X | aking the values x_i with the *probabilites* p_i,

$$E(X) = \sigma'' p_i x_i$$

the sum being extended over all the values x_i which can be taken by X .

b) For a continuous *random variable* X | aving the probability density function $f(x)$,

$$E(X) = \int x f(x)\, \mathrm{d}x$$

the integral being extended over all values of the interval of variation of X .

Note 1 — No distinction is made between the *expectation* | f a *random variable* | nd that of a *probability* distribution.

Note 2 — The term *mean* | s also used with other meanings, for example as the normalized integral over a *time interval* .

2009 **variance** (of a random variable)

F: *variance* (d'une variable al´eatoire)

S: *varianza* (de una variable aleatoria)

The *expectation* | f the square of the difference between a *random variable* | nd the *expectation* of this variable.

2010 **standard deviation,** δ (symbol)

F: *´ecart-type,* δ (symbole)

S: *desviaci´on t´ipica,* δ (s´imbolo)

The positive square root of the *variance* .

2011 **observed value** (in statistics)

F: *valeur observ´ee* (en statistique)

S: *valor observado* (en estad´istica)

The value of a *characteristic* | etermined as the result of an observation or *test* .

2012 **relative frequency**

F: *fr´equence (statistique)*

S: *frecuencia relativa*

The ratio of the number of times a particular value, or a value falling within a given class, is observed to the total number of observations.

2013 **statistical test**

F: *test (statistique)*

S: *prueba estad´istica*

A procedure that is intended to decide whether a hypothesis about the distribution of one or more populations should be rejected or not rejected (accepted).

Note 1 — The decision taken is a result of the value of an appropriate *statistic* | r *statistics* , calculated from values observed in samples taken from the populations under consideration. As the value of the *statistic* is subject to random variations, there is some risk of *error* when the decision is taken.

Note 2 — It is important to note that, generally speaking, a *test* | ssumes *a priori* | hat certain assumptions are fulfilled (for example, assumption of independence of the observations, assumption of normality, etc.). These assumptions serve as a basis of the *test* .

2014 **one-sided test**

F: *test unilat´eral*

S: *prueba unilateral*

A *statistical test* | n which the *statistic* | sed is one-dimensional and the *critical region* is the set of values lower than, or the set of values greater than, a given number.

2015 **two-sided test**

F: *test bilat´eral*

S: *prueba bilateral*

A *statistical test* | n which the *statistic* | sed is one-dimensional and in which the *critical region* is the set of values lower than a first given number and the set of values greater than a second given number.

2016 **null hypothesis, H↓0** (symbol)

F: *hypoth`ese nulle,* H_0(symbole)

S: *hip´otesis nula,* H_0(s´imbolo)

The hypothesis to be rejected or not rejected (accepted) at the outcome of the *statistical test* .

2017 **alternative hypothesis, H↓1** (symbol)

F: *hypoth`ese alternative,* H_1 | symbole)

S: *hip´otesis alternativa,* H_1 | s´imbolo)

The hypothesis, usually composite, which is opposed to the *null hypothesis*

2018 **critical region**

F: *r´egion critique*

S: *regi´on cr´itica*

The set of possible values of the *statistic* | sed such that, if the value of the *statistic* | hich results from the *observed values* belongs to the set, the *null hypothesis* will be rejected, whereas it will not be rejected (accepted) if the opposite is the case.

2019 **critical values**

F: *valeurs critiques*

S: *valores cr´iticos*

The given value(s) which limit the *critical region* .

2020 **error of the first kind**

F: *erreur de premi`ere esp`ece*

S: *error de primera clase*

The *error* | ommitted in rejecting the *null hypothesis* , because the *statistic* | akes a value which belongs to the *critical region* , when the *null hypothesis* is true.

2021 **type I risk**

F: *risque de premi`ere esp`ece*

S: *riesgo de tipo I*

The *probability* | f committing the *error of the first kind* , which varies according to the real situation (within the framework of the *null hypothesis*). Its maximum value is the *significance level* of the *statistical test* .

2022 **error of the second kind**

F: *erreur de seconde esp`ece*

S: *error de segunda clase*

The *error* | ommitted in failing to reject (accept) the *null hypothesis* | because the value of the *statistic* does not belong to the *critical region*), when the *null hypothesis* is not true (the *alternative hypothesis* therefore being true).

2023 **type II risk**

F: *risque de seconde esp`ece*

S: *riesgo de tipo II*

The *probability* , designated β, of committing the *error of the second kind* . Its value depends on the real situation and can only be calculated if the *alternative hypothesis* is adequately specified.

2024 **operating characteristic curve; OC curve** (for a statistical test plan)

F: *courbe d'efficacit´e* (d'un plan de test)

S: *curva caracter´istica de funcionamiento* (para un plan de prueba estad´istica)

A curve showing, for a given *statistical test* | lan, the *probability of acceptance* | s a function of the actual value of a given *measure* .

2025 **producer's risk (point)**

F: (point du) risque du fournisseur

S: (punto de) riesgo del proveedor

A point on the *operating characteristic curve* | orresponding to some predetermined and usually low *probability of rejection* .

2026 **consumer's risk (point)**

F: (point du) risque du client

S: (punto de) riesgo del consumidor

A point on the *operating characteristic curve* | orresponding to a predetermined and usually low *probability of acceptance* .

2027 **power of the test**

F: puissance du test

S: potencia de la prueba

The *probability* | f not committing the *error of the second kind* , equal to 1 | (em | (*a, and thus the *probability* of rejecting the *null hypothesis* when this hypothesis is false.

2028 **significance level** (of a statistical test), α (symbol)

F: niveau de signification (d'un test); *seuil de signification,* α | (symbole)

S: nivel de significaci´on (de una prueba estad´istica); *umbral de significaci´on,* α | (s´imbolo)

The given value which limits the *probability* | f the *null hypothesis* | eing rejected, if the *null hypothesis* is true.

Note — The *critical region* | s determined in such a way that if the *null hypothesis* | s true, the *probability* of this *null hypothesis* being rejected should be not more than this given value.

2029 **probability of acceptance**

F: probabilit´e d'acceptation

S: probabilidad de aceptaci´on

The *probability* | hat an *item* | ill be accepted by a given *statistical test* | lan.

2030 **probability of rejection**

F: probabilit´e de rejet

S: probabilidad de rechazo

The *probability* | hat an *item* | ill not be accepted by a given *statistical test* | lan.

2031 **confidence interval**

F: *intervalle de confiance*

S: *intervalo de confianza*

The random interval limited by two *statistics* | r by a single *statistic* , such that the *probability* that a parameter to be estimated is covered by this interval is equal to a given value 1 | (em | (*a, where α is the *significance level* .

2032 **statistical tolerance interval**

F: *intervalle statistique de dispersion*

S: *intervalo estad´istico de tolerancia*

A random interval limited by two *statistics* | r by a single *statistic* , such that the *probability* that a fraction of the population, equal to or greater than a given value between 0 and 1, is covered by this interval is equal to a given value 1 | (em | (*a, where α is the *significance level* .

2033 **confidence limit**

F: *limite de confiance*

S: *l´imite de confianza*

Each of the limits of a two-sided *confidence interval* , or the single limit of a one-sided *confidence interval* .

2034 **estimation**

F: *estimation (de param`etres)*

S: *estimaci´on (de par´ametros)*

The operation made for the purpose of assigning, from the observed values in a sample, numerical values to the parameters of the distribution chosen as the statistical model of the population from which this sample is taken.

2035 **estimate**

F: *estimation*

S: *estimaci´on*

The result of an *estimation* .

Note — This result may be expressed either as a single numerical value (point estimation) or as a *confidence interval* .

2036 **estimator**

F: *estimateur*

S: *estimador*

A *statistic* | ntended to estimate a population parameter.

2037 **confidence coefficient; confidence level**

F: *niveau de confiance*

S: *coeficiente de confianza; nivel de confianza*

The value 1 | (em | (*a of the *probability* | ssociated with a *confidence interval* | r a *statistical tolerance interval* , where α is the *significance level* .

2038 **statistic**

F: *statistique*

S: *estad´istico*

A function of the *observed values* | erived from a sample.

2039 **acceptable level** (of a measure)

F: *niveau acceptable* (d'une caract´eristique)

S: *nivel aceptable* (de una medida)

A level for a *measure* | f a given performance which in a *test* | lan corresponds to a specified but relatively high *probability of acceptance* .

ANNEX A
(to Supplement 6)

Alphabetical list of definitions contained in this Supplement

2 col 9107 accelerated test

2039 acceptable level

7209 accumulated down time

3010 accumulated time

7107 active corrective maintenance time

7103 active maintenance time

7106 active preventive maintenance time

9302 active redundancy

7107 active repair time

7109 administrative delay

5209 ageing failure

5311 ageing fault

2017 alternative hypothesis

8105 asymptotic availability

8106 asymptotic unavailability

8107 asymptotic mean availability

8108 asymptotic mean unavailability

6012 automatic maintenance

8105 availability

4002 availability performance

1007 average (deprecated)

5102 bug

9502 burn in

5509 busy state

5212 cataleptic failure

5212 catastrophic failure (deprecated)

2001 characteristic

7113 check-out time

2035	estimate
1004	estimated . | |
2034	estimation
2036	estimator
5402	execution error
2008	expectation
5506	external disabled state
7210	external disabled time
7210	external loss time
1003	extrapolated . | |
9304	fail safe
5201	failure

9201	observed data
2011	observed value
2024	OC curve
6010	off-site maintenance
2014	one-sided test
6009	on-site maintenance
2024	operating characteristic curve
5501	operating state
7201	operating time
3012	operation
1006	operational . | |
5505	outage
5315	partial fault
5316	permanent fault
5316	persistent fault
2007	p-fractile (of a probability distribution)
1008	p-fractile . | |
8309	p-fractile active repair time
8402	p-fractile administrative delay
8404	p-fractile logistic delay
8307	p-fractile repair time
8101	pointwise availability
8102	pointwise unavailability
2027	power of the test
1002	predicted . | |
9401	prediction
6004	preventive maintenance
7104	preventive maintenance time
5215	primary failure
2002	probability
2006	probability density function
2029	probability of acceptance

6011	remote maintenance
6005	repair
8312	repair coverage
8302	repair rate
7105	repair time
3002	repaired item
5219	reproducible failure
3005	required function
7203	required time
6029	restoration
6007	scheduled maintenance
5216	secondary failure
9109	screening test
2028	significance level
5316	solid fault
2010	standard deviation
9303	standby redundancy
5503	standby state
7205	standby time
9409	state-transition diagram
2038	statistic
2013	statistical test
2032	statistical tolerance interval
8105	steady-state availability
9108	step stress test
9406	stress analysis
9410	stress model
5210	sudden failure
6001	supervision
5219	systematic failure

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5321 systematic fault

7112 technical delay

9101 test

9202 test data

9110 time acceleration factor

7303 time between failures

3009 time duration

7302 time to failure

7301 time to first failure

3008 time interval

7304 time to recovery

7304 time to restoration

5317 transient fault

1001 true . | |

2015 two-sided test

2021 type I risk

2023 type II risk

7108 undetected fault time

5508 up state

7211 up time

6008 unscheduled maintenance

7305 useful life

2009 variance

9203 variate

5317 volatile fault

5206 weakness failure

5308 weakness fault

5209 wearout failure

5311 wearout fault

7309 wear-out failure period

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ANNEX B
(to Supplement 6, Part I)

Relations between defect, failure and fault concepts

H.T. [T1.6]
TABLE B-1

Defect	Failure	Fault
Critical defect	Critical failure	Critical fault
Non-critical defect	Non-critical failure	Non-critical fault
Major defect	—	Major fault
Minor defect	—	Minor fault
—	Misuse failure	Misuse fault
—	Mishandling failure	Mishandling fault
—	Inherent weakness failure	Inherent weakness fault
Design defect	Design failure	Design fault
Manufacturing defect	Manufacturing failure	Manufacturing fault
—	Ageing failure	Ageing fault
—	Sudden failure	—
—	Gradual failure	—
—	Cataleptic failure	—
—	Relevant failure	—
—	Non-relevant failure	—
—	Primary failure	—
—	Secondary failure	—
—	Failure cause	—
—	Failure mechanism	—
—	—	Programme-sensitive fault
—	—	Data-sensitive fault
—	—	Complete fault
—	—	Partial fault
—	—	Persistent fault
—	—	Intermittent fault
—	—	Fault mode
—	—	Determinate fault
—	—	Indeterminate fault
—	—	Latent fault
—	Systematic failure	Systematic fault
Bug	—	—

Table B-1/Sup. 6 [T1.6], p.

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ANNEX C

(to Supplement 6, Part I)

List of recommended symbols and abbreviations

α	Significance level
β	Type II risk
$\lambda(t)$	Instantaneous failure rate
$\lambda (t_1, \mid \text{fIt}_2)$	Mean failure rate [in time interval $(t_1, \mid \text{fIt}_2)$]
$\mu(t)$	Instantaneous repair rate
$\mu \mid (t_1, \mid \text{fIt}_2)$	Mean repair rate [in time interval $(t_1, \mid \text{fIt}_2)$]
δ	Standard deviation
A	Asymptotic availability
$A (t)$	Instantaneous availability
$A \mid$	Asymptotic mean availability
$A \mid (t_1, \mid \text{fIt}_2)$	Mean availability [in time interval $(t_1, \mid \text{fIt}_2)$]
ASR	Answer seizure ratio
$E (X)$	Mean (of X)
$f (x)$	Probability density function
$F (x)$	Distribution function
FMEA	Fault modes and effect analysis
FMECA	Fault modes, effects and criticality analysis
FTA	Fault tree analysis
H_0	Null hypothesis
H_1	Alternative hypothesis
MAD	Mean administrative delay
MADT	Mean accumulated down time
MART	Mean active repair time
MDT	Mean down time
MLD	Mean logistic delay
MMH	Maintenance man-hours
MRT	Mean repair time
MTBF	Mean time between failures
MTTF	Mean time to failure
MTTFF	Mean time to first failure

MTTR Mean time to restoration

MUT Mean up time

$N(t_1, t_2)$ Number of failures [in time interval (t_1, | fIt$_2$)]

R Reliability

U Asymptotic unavailability

$U(t)$ Instantaneous unavailability

U | Asymptotic mean unavailability

U | (t_1, | fIt$_2$) Mean unavailability [in time interval (t_1, | fIt$_2$)]

$z(t)$ Instantaneous failure intensity

z | (t_1, | fIt$_2$) Mean failure intensity [in time interval (t_1, | fIt$_2$)]

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Supplement No. 7

GUIDE FOR EVALUATING AND IMPLEMENTING | fR ALTERNATE ROUTING NETWORKS

A systematic procedure consisting of a number of distinct steps is used for the evaluation of alternate routing networks.

These steps are given in the flowchart of Annex A and are provided as guidance. Administrations may wish to expand, delete or change the order of these steps to meet circumstances.

The steps may be grouped into the following six processes:

— Identification of alternate route.

— Preliminary screening.

— Data gathering.

— Evaluation.

— Implementation.

— Monitoring.

1 Identification of alternate route

A terminal Administration selects an alternate route.

A tentative agreement is reached with the opposite terminal Administration to use the selected alternate route, and both terminal Administrations reach tentative agreement with the transit Administration to explore the use of its network as an alternate route.

If no tentative agreements are reached, another alternate route is selected or if none is available, the procedure is abandoned.

2 Preliminary screening

Using available data, the organizational elements of the terminal Administrations responsible for transmission, routing and call completion, analyse the feasibility of utilizing the alternate route.

If an objection is raised, another alternate route is selected or, if none is available, the procedure is abandoned.

3 Data gathering

A questionnaire is issued to all Administrations involved to obtain additional information before an evaluation is made of the proposed alternate route.

The questionnaire can include requests for transmission, routing, call completion rates, traffic profiles, circuit costs, and transit charges.

If there is no response to the questionnaire or if the information provided indicates that the alternate route is unsuitable, another alternate route is selected or, if none is available, the procedure is abandoned.

4 Evaluation

The alternate routing network is dimensioned according to Recommendation E.522.

If additional circuits are required on the alternate route, and the required increment exceeds the available capacity, another alternate route is selected. If no other alternate route is available Administrations may choose to retain the selected alternate route and accept a cost disadvantage.

5 Implementation

Final negotiations are carried out and approval of all Administrations involved in the alternate route network is sought.

The negotiations would include the reporting procedure and responsibility for recording traffic overflowing to the alternate route.

If final agreement cannot be reached, another alternate route is selected or, if none is available, the procedure is abandoned.

6 Monitoring

Traffic volumes and performance data for the alternate route are recorded and exchanged at regular intervals.

ANNEX A

(to Supplement No. 7)

Flowchart of evaluation and implementation procedure for alternate routing networks

Figure A-1, p.

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Figure A-2, p.