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TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE
AND LEASED CIRCUITS

International transport network

**Performance limits and objectives for bringing-
into-service and maintenance of international
SDH paths and multiplex sections**

ITU-T Recommendation M.2101

(Formerly CCITT Recommendation)

ITU-T M-SERIES RECOMMENDATIONS

TMN AND NETWORK MAINTENANCE: INTERNATIONAL TRANSMISSION SYSTEMS, TELEPHONE CIRCUITS, TELEGRAPHY, FACSIMILE AND LEASED CIRCUITS

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ITU-T Recommendation M.2101

Performance limits and objectives for bringing-into-service and maintenance of international SDH paths and multiplex sections

Summary

This ITU-T Recommendation provides limits for Bringing-Into-Service (BIS) and maintenance for international SDH paths, including tandem connections, and international SDH multiplex sections using equipment designed according to ITU-T Recommendation G.828. Error, timing and availability performance events are addressed. This ITU-T Recommendation also deals with all levels of PDH signals transported within SDH containers. Regenerator sections are not covered by this ITU-T Recommendation. BIS limits and maintenance procedures for radio regenerator sections are described in the relevant ITU-R Recommendations. SDH systems designed according to ITU-T Recommendation G.826 (i.e. prior to the approval of ITU-T Recommendation G.828) are not required to be re-engineered to meet the objectives and limits of this ITU-T Recommendation.

Maintenance of systems designed to ITU-T Recommendation G.826 should use the limits given in ITU-T Recommendation M.2101.1.

Source

ITU-T Recommendation M.2101 was revised by ITU-T Study Group 4 (1997-2000) and approved under the WTSC Resolution 1 procedure on 15 June 2000.

Keywords

Allocated Performance Objective (APO), Bringing-Into-Service (BIS), Bringing-Into-Service Performance Objective (BISPO), Degraded Performance Limit (DPL), Errored Second (ES), Limits, Maintenance, Performance Objectives, Severely Errored Second (SES), Severely Errored Period (SEP), Tandem Connection Monitoring (TCM), Unacceptable Performance Limit (UPL).

FOREWORD

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The World Telecommunication Standardization Conference (WTSC), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSC Resolution 1.

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NOTE

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Introduction

This ITU-T Recommendation provides limits for bringing-into-service, and limits for maintenance of international SDH paths and international SDH multiplex sections in order to achieve the performance objectives given for a multi-service environment. These objectives include error performance (ITU-T Recommendation G.828), timing performance (ITU-T Recommendation G.822) and availability (ITU-T Recommendation G.827). This ITU-T Recommendation defines the parameters and their associated objectives in order to respect the principles given in ITU-T Recommendations M.20, M.32 and M.34. "International" in this ITU-T Recommendation refers to SDH paths and multiplex sections which cross international boundaries with a change in jurisdictional responsibility.

The SDH signal format and structure are described in ITU-T Recommendations G.707 and G.708. The long-term error performance objectives for SDH paths are given in ITU-T Recommendation G.828. For availability performance, ITU-T Recommendation G.827 provides the long-term requirements. Availability performance requirements from a short-term maintenance perspective are under study.

ITU-T Recommendation G.803 provides a modelling method for describing the functions which exist or are required to make up a telecommunications network. This modelling method has been used where appropriate within this ITU-T Recommendation.

The methods and procedures for applying these limits are described in ITU-T Recommendation M.2110 for the bringing-into-service procedures and in ITU-T Recommendation M.2120 for the maintenance procedures.

This ITU-T Recommendation uses certain principles that form the basis of the maintenance of a digital network:

- It is desirable to do in-service, continuous measurements. In some cases, out-of-service measurements may be necessary.
- A single set of parameters must be used for maintenance of the SDH hierarchy (see ITU-T Recommendation G.702) however the actual limits are bit rate dependent.
- Error performance limits of international SDH paths and multiplex sections are dependent on the medium used.

The reasons for revising this ITU-T Recommendation include the addition of Tandem Connection Monitoring (TCM), Background Block Error (BBE) measurements and the Severely Errored Period (SEP) event in accordance with ITU-T Recommendation G.828 (and ITU-T Recommendation G.826 for BBE only)¹.

The use of the SEP event and limits for maintenance are under study.

¹ BBE measures will not be required for installed equipment.

ITU-T Recommendation M.2101

Performance limits and objectives for bringing-into-service and maintenance of international SDH paths and multiplex sections

1 Scope

Within the scope of this ITU-T Recommendation are bringing-into-service and maintenance of international SDH paths and multiplex sections and also SDH signals transported over PDH networks. For the case of PDH signals transported over SDH networks, ITU-T Recommendation M.2100 [16] applies to the PDH path. For the case of mixed PDH/SDH terminated paths, ITU-T M.2100 [16] applies (at the PDH bit rate). Further guidance is given in the main body of this ITU-T Recommendation on how ITU-T M.2100 [16] and ITU-T M.2101 relate. "International" in this ITU-T Recommendation refers to SDH paths and multiplex sections which cross international boundaries with a change in jurisdictional responsibility. SDH regenerator sections are not covered by this ITU-T Recommendation. By bilateral agreement, ITU-R Recommendation F.1330-1 [21] may be used in conjunction with this Recommendation for radio-relay systems where applicable. Maintenance of SDH systems designed to ITU-T Recommendation G.826 [8] should use the limits given in ITU-T Recommendation M.2101.1 [17].

The use of the SEP event and limits for maintenance are under study².

This ITU-T Recommendation does not consider commissioning of SDH equipment into the network. The SDH VC-11 bit rate is the lowest considered by this ITU-T Recommendation. It does not, therefore, consider 64 kbit/s circuits or sub-64 kbit/s, which are dealt with by ITU-T Recommendations M.2100 [16] and M.1340 [15].

Limits for BIS and maintenance are given for Virtual Containers (VC) and Synchronous Transport Module-N (STM-N). Limits are also given for triggering maintenance activity (e.g. repair, fault localization, etc.).

Methods of deriving performance information from Bit Interleaved Parity-Ns (BIP-N) and other path overhead information are given. Tandem connection monitoring is considered in this ITU-T Recommendation. The guidance given in this ITU-T Recommendation in terms of performance limits for maintenance purposes, and that given in the companion ITU-T Recommendations M.2110 [18] and M.2120 [19] provide a consistent platform from which the requirements for a maintenance management system can be derived.

2 References

The following ITU-T Recommendations and other references contain provisions which, through reference in this text, constitute provisions of this Recommendation. At the time of publication, the editions indicated were valid. All Recommendations and other references are subject to revision; all users of this Recommendation are therefore encouraged to investigate the possibility of applying the most recent edition of the Recommendations and other references listed below. A list of the currently valid ITU-T Recommendations is regularly published.

² As provided in section 8.5.4 of Resolution 1 of the 1996 WTSC, the United States of America registers a degree of reservation against the use of the objectives in Tables 3a/ M.2101 and D.14/M.2101, and intends to treat the values of these tables as though their entries were designated "FFS", i.e. for further study. As the text of ITU-T Recommendation G.828, approved in Kyoto in March 2000, places no numeric end-to-end performance objectives on the SEPI parameter, the use of numeric maintenance objectives in ITU-T Recommendation M.2101 is unjustified.

- [1] CCITT Recommendation G.702 (1988), *Digital hierarchy bit rates*.
- [2] ITU-T Recommendation G.707 (1996), *Network node interface for the Synchronous Digital Hierarchy (SDH)*.
- [3] ITU-T Recommendation G.708 (1999), *Sub-STM-0 Network Node Interface for the Synchronous Digital Hierarchy (SDH)*.
- [4] ITU-T Recommendation G.784 (1999), *Synchronous digital hierarchy (SDH) management*.
- [5] ITU-T Recommendation G.803 (2000), *Architectures of transport networks based on the Synchronous Digital Hierarchy (SDH)*.
- [6] CCITT Recommendation G.822 (1988), *Controlled slip rate objectives on an international digital connection*.
- [7] ITU-T Recommendation G.825 (2000), *The control of jitter and wander within digital networks which are based on the Synchronous Digital Hierarchy (SDH)*.
- [8] ITU-T Recommendation G.826 (1999), *Error performance parameters and objectives for international, constant bit-rate digital paths at or above the primary rate*.
- [9] ITU-T Recommendation G.827 (2000), *Availability parameters and objectives for path elements of international constant bit-rate digital paths at or above the primary rate*.
- [10] ITU-T Recommendation G.828 (2000), *Error performance parameters and objectives for international, constant bit-rate synchronous digital paths*.
- [11] ITU-T Recommendation G.829 (2000), *Error performance events for SDH multiplex and regenerator sections*.
- [12] CCITT Recommendation M.20 (1992), *Maintenance philosophy for telecommunications networks*.
- [13] CCITT Recommendation M.32 (1988), *Principles for using alarm information for maintenance of international transmission systems and equipment*.
- [14] CCITT Recommendation M.34 (1988), *Performance monitoring on international transmission systems and equipment*.
- [15] ITU-T Recommendation M.1340 (1996), *Performance allocations and limits for international data transmission links and systems*.
- [16] ITU-T Recommendation M.2100 (1995), *Performance limits for bringing-into-service and maintenance of international PDH paths, sections and transmission systems*.
- [17] ITU-T Recommendation M.2101.1 (1997), *Performance limits for bringing-into-service and maintenance of international SDH paths and multiplex sections*.
- [18] ITU-T Recommendation M.2110 (1997), *Bringing-into-service of international PDH paths, sections and transmission systems and SDH paths and multiplex sections*.
- [19] ITU-T Recommendation M.2120 (2000), *PDH path, section and transmission system and SDH path and multiplex section fault detection and localization procedures*.
- [20] ITU-T Recommendation O.181 (1996), *Equipment to assess error performance on STM-N interfaces*.
- [21] ITU-R Recommendation F.1330-1 (1999), *Performance limits for bringing-into-service of the parts of international plesiochronous digital hierarchy and synchronous digital hierarchy paths and sections implemented by digital radio-relay systems*.

3 Terms and definitions

This ITU-T Recommendation defines the following terms:

3.1 usage of the terms "path" and "multiplex section" in this Recommendation: The terms "path" and "multiplex section" describe unidirectional transport entities. For a bidirectional path or multiplex section all objectives, limits, etc. should be applied to each direction of the trail independently from the other direction. This means that for maintenance purposes, performance shall be evaluated per direction, i.e. events occurring on the A-Z direction shall not have any impact on the evaluation of performance events occurring on the Z-A direction, and vice versa.

3.2 performance objective (PO): Performance objective for the international portion of the hypothetical reference path (see Figure 3/G.828 [10]) or multiplex section.

3.3 allocated performance objective (APO): Performance objective for a real path calculated according to the allocation rules.

3.4 bringing-into-service performance objective (BISPO): Bringing-into-service performance objective for a real path or multiplex section calculated from its APO.

3.5 international portion: An international digital path can be subdivided into two national portions and one international portion. The boundary between these portions is defined to be an International Gateway.

The national portion is outside the scope of this ITU-T Recommendation.

3.6 international gateway (IG): International VC-*n* Sink/Source equipment [or VC-4 in case of interconnected networks based on different Administrative Units (AU)].

3.7 path core elements (PCE): An international digital path has been partitioned in geographical terms for the purpose of allocating the Performance Objectives (POs). These portions have been titled Path Core Elements (PCEs).

Two types of international PCE are used:

- an International Path Core Element (IPCE) is between an IG and a Frontier Station (FS) in a terminating country, or between FSs in a transit country (see definition of IG in 3.6);
- an Inter-Country Path Core Element (ICPCE) is between the agreed frontier stations of the two countries involved. The ICPCE corresponds to the highest-order digital standardized trail carried on a digital transmission system linking the two countries. An ICPCE may be transported on a terrestrial, satellite or undersea cable transmission system.

There are two cases where a country may not contain an IPCE:

- depending on the geographical situation and network topology, the IG may coincide with the FS in a terminating country;
- the path uses only one FS in a transit country.

3.8 the international boundary and border crossing points: The International Boundary, the point at which control transfers from one international operator to the next international operator, normally exists within the ICPCE. Generally, this would be half-way along a submarine cable or terrestrial border crossing ICPCE. The Border Crossing Point may coincide with the International Boundary (for example, for a terrestrial border crossing ICPCE) or, in the case of a submarine cable (for example), there would be two border crossings, corresponding to the coastline of the operator's country, which would not coincide with the International Boundary.

3.9 international paths operating in tandem: International paths may operate in tandem where network topology requires links between certain terminating countries to be established. The restriction is that the allocation must not exceed 63%.

NOTE – ITU-T Recommendation G.828 [10] allocates a block allowance of 17.5% of the overall performance objectives to one national portion of a path. In addition, a length-dependent allowance of 0.2% per 100 km is allocated to this portion. Considering that a path comprises two national portions and assuming a minimum length of 2×500 km, the total allocation assigned to the national portion is:

$$2 \times 17.5\% + 2 \times 1.0\% = 37.0\%$$

Because this ITU-T Recommendation only deals with the **international portion**, only:

$$100\% - 37\% = 63\%$$

can be assigned to the **international** portion.

3.10 in-service measurement points: The full definitions of sections and paths are given in ITU-T Recommendation G.803 [5]. The following definitions are for use with this ITU-T Recommendation, and are for guidance only. See also ITU-T Recommendation G.803 [5] for an illustration of these objects.

3.11 STM-N section network connection: The link between STM-N Section Network Connection termination points. Examples include point-to-point submarine cables and border crossings. This is the highest bit-rate part of the SDH transmission network. It would not normally be possible to make any measurements of this.

3.12 STM-N section trail: The STM-N Section Network Connection and its termination points. Since this includes termination points, measurements can be made.

This ITU-T Recommendation gives performance limits for international STM-N multiplex section trails, which will be the case for some submarine cables, satellite links or terrestrial border crossings. Where STM-N section trails are operating in tandem across a given operator's territory to make up its Path Core Element, it is the responsibility of the operator to ensure that the performance of the Section Trails operating in tandem meets the requirements for its Path Core Element, as given in this ITU-T Recommendation.

3.13 STM-N termination point: Terminates the STM-N Section Network Connection, and interfaces with the adaptation function. At this point, the STM-N Section Overhead is removed.

3.14 STM-N adaptation function: Multiplexes between the Higher-Order Path Layer and the STM-N Section layer. It interfaces the STM-N Termination point with either the Higher-Order Path Trail termination point or a Higher-Order Path Sub-network Connection.

3.15 higher-order path sub-network connection: Provides connectivity between STM-N/HOPL adaptation functions, permitting higher-order VCs (VC-3³, VC-4) to be connected between STM-N Section Trails. Add-drop multiplexers or cross-connects would normally provide this type of connection.

3.16 higher-order path trail: Exists between and includes the Higher-Order Path Termination Points. Since it is terminated, measurements can be made over this trail. It is made up of one or more STM-N Section Trails operating in tandem, and therefore also includes one or more Higher-Order Path Sub-Network Connections.

Performance limits for Higher-Order path trails (VC-3s and VC-4s) will only be given by this ITU-T Recommendation when the VC-3 or VC-4 is the end-to-end path solely under consideration, or when the Higher-Order Path Trail corresponds directly to a Path Core Element. In the case where one operator's Path Core Element is made up of a number of Higher-Order path trails operating in tandem, it is the responsibility of that operator to ensure that the performance of those trails operating in tandem meets the performance limit for its PCE.

³ Note that the Virtual Container 3 (VC-3) can be considered to be either a lower-order or a higher-order VC.

3.17 higher-order adaptation function: Multiplexes between the higher-order path layer (a given higher-order path trail) and the lower-order path layer, interfacing to the higher-order trail termination points, and either the lower-order trail termination point or to a Lower-Order Path Sub-Network Connection.

3.18 lower-order path sub-network connection: Provides a link between higher-order to lower-order path layer adaptation functions. This link would normally exist inside equipment such as an add-drop multiplexer or cross-connect. It allows higher-order path trails to operate in tandem in order to make up a Lower-Order path trail.

3.19 lower-order path trail: Exists between and includes the Lower-Order Path Trail Termination Points, where the VC-1, -2 or -3 overhead is removed. Measurements can therefore be made of this object. Performance limits are given in this ITU-T Recommendation for Lower-Order Path Trails.

4 Abbreviations

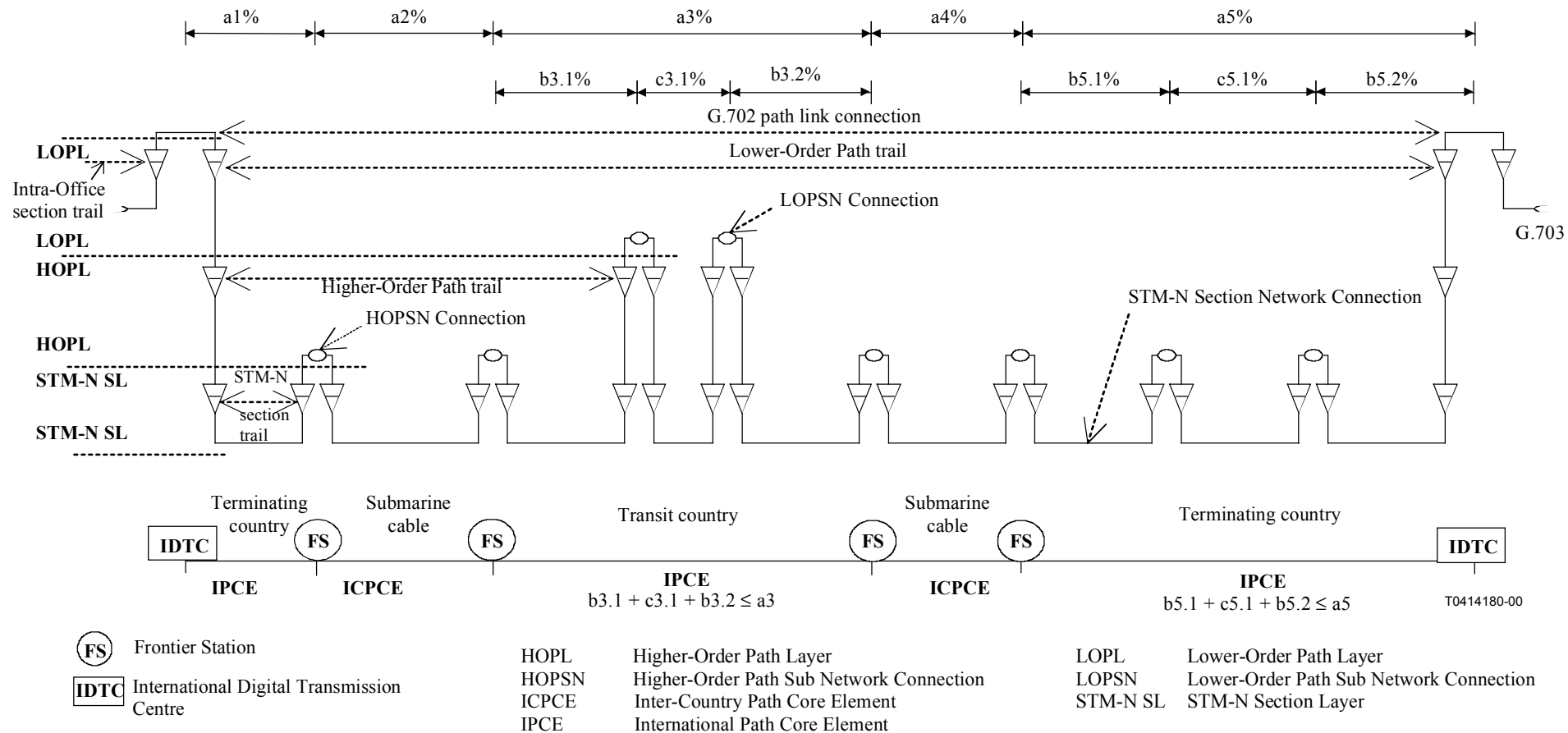
This ITU-T Recommendation uses the following abbreviations:

AIS	Alarm Indication Signal
APO	Allocated Performance Objective
AU	Administrative Unit
BBE	Background Block Error
BER	Bit Error Ratio
BIP	Bit Interleaved Parity
BIS	Bringing-Into-Service
BISPO	BIS Performance Objective
DPL	Degraded Performance Limit
DXC	Digital Cross-Connect
ES	Errored Second
FAS	Frame Alignment Signal
FS	Frontier Station
HOPL	Higher-Order Path Layer
HPTC	Higher-Order Path Tandem Connection
IB	International Border
ICPCE	Inter-Country Path Core Element
IDTC	International Digital Transmission Centre
IG	International Gateway
IPCE	International Path Core Element
IS	In-Service
LOF	Loss of Frame
LOP	Loss of Pointer
LOPL	Lower-Order Path Layer
LOS	Loss of Signal

LPTC	Lower-Order Path Tandem Connection
LTC	Loss of Tandem Connection
MS	Multiplex Section
OOS	Out-of-Service
PCE	Path Core Element
PDH	Plesiochronous Digital Hierarchy
PEP	Path End Point
PO	Performance Objective
PRBS	Pseudo-Random Binary Sequence
Rf	routing factor
RS	Regenerator Section
SDH	Synchronous Digital Hierarchy
SEP	Severely Errored Period
SEPI	Severely Errored Period Intensity
SES	Severely Errored Second
STM	Synchronous Transport Module
TC	Tandem Connection
TCM	Tandem Connection Monitoring
TSS	Test Signal Sequence
UPL	Unacceptable Performance Limit
VC	Virtual Container

5 Hypothetical reference model

For performance of international path and multiplex section layers, the physical relationship between the international LOPL, HOPL and STM-N Section Layers is illustrated in Figure 1.



NOTE 1 – According to ITU-T Recommendations G.826 and G.828, the Allocated Performance Objective of the international portion must not exceed 63% of the Performance Objective.

NOTE 2 – A common international portion consists of two terminating countries (IPCEs), and one submarine cable, satellite system or terrestrial border crossing (ICPCE). The physical endpoints of the international portion exist within IDTCs; the IDTC corresponds to one of the IGs (International Gateways) as given in ITU-T Recommendations G.826 and G.828.

NOTE 3 – More complex path structures may include transit countries, which would exist between the two terminating countries linked by IPCE (terrestrial border crossings, submarine cables or satellite links). ICPCEs operating in tandem are acceptable (e.g. submarine cables operating in tandem).

NOTE 4 – This international path allocation shows the relationship between Path Core Elements and ITU-T Recommendation G.803 network modelling. Please see Figure 4-1/G.803 for a precise network model.

Figure 1/M.2101 – Example of apportionment for an international path

6 Allocation principles for end-to-end VC connections

This clause specifies the allocation of error performance objectives for the international portion of international digital paths, in terms of PCEs as shown in Figure 2.

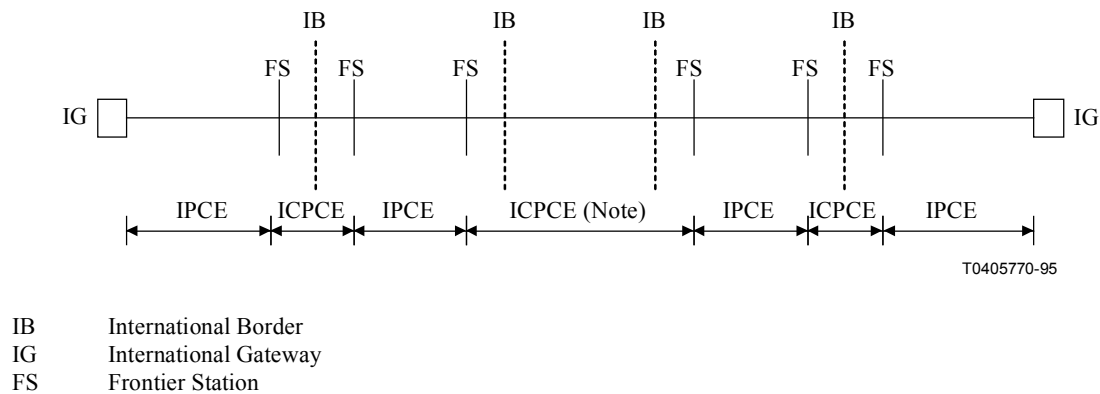


Figure 2/M.2101 – Example of the components of a path to show PCEs

It is the responsibility of each country to design its network in a way that is consistent with its PCE country allocation for the international path. The allocation of each portion of the international path can be determined from the values given in Table 2a; the allocation for multiplex sections is given in Table 2b. These allocations are a percentage of the end-to-end PO. Distances referred to in Tables 2a and 2b are actual distances, or great circle (also called air-route or air-mile) distances multiplied by the routing factor (rf), whichever is less. See Table 1.

Table 1/M.2101 – PCE great circle length vs. routing factor

PCE great circle length	Routing Factor (rf)
$d < 1000$ km	1.5
$1000 \text{ km} \leq d < 1200$ km	Assume 1500 km
$d \geq 1200$ km	1.25

As shown in Figure 1, it is possible that access to the bit stream for a given path may not coincide with the end of a PCE. In this case, or if a transit country has other access points within its network, it may be necessary to make a sub-allocation for maintenance purposes, e.g. fault localization as described in ITU-T Recommendation M.2120 [19]. Such sub-allocations will be the responsibility of the national network operator(s) of the country involved, with the following constraints:

- the sum of sub-allocations may not exceed the allocation of Table 2a for the PCE in question;
- the values of the sub-allocations must be communicated to all maintenance centres involved before bringing the path into service and after any rearrangement which changes the values.

Table 2a/M.2101 – Maximum allocation of PO to Path Core Elements

PCE classification	Allocation (% of end-to-end PO)
IPCE	
Terminating/Transit national network:	
$d \leq 100$ km	1.2
$100 \text{ km} < d \leq 200$ km	1.4
$200 \text{ km} < d \leq 300$ km	1.6
$300 \text{ km} < d \leq 400$ km	1.8
$400 \text{ km} < d \leq 500$ km	2
$500 \text{ km} < d \leq 1000$ km	3
$1000 \text{ km} < d \leq 2500$ km	4
$2500 \text{ km} < d \leq 5000$ km	6
$5000 \text{ km} < d \leq 7500$ km	8
$d > 7500$ km	10
ICPCE (Note)	
Optical undersea cable:	
$d \leq 500$ km	1
$d > 500$ km	2.5
Satellite:	
Normal operation	35
Wideband cable restoration mode	35
Terrestrial:	
$d < 300$ km	0.3
NOTE – ICPCE allocations must be met regardless of how many MS make up the ICPCE.	

Table 2b/M.2101 – Maximum allocation of PO to international multiplex sections

Facility type	Allocation (% of end-to-end PO)
Terrestrial	0.2
Satellite	35
Optical undersea cable	
$d < 500$ km	0.2
$d > 500$ km	0.5

VC connections using rings – For the purpose of calculating error performance limits for paths transported by SDH rings, the Path End Points should first be identified, and then the performance allocated in the normal way, using the air-route distance multiplied by the routing factor. This will result in only one set of error performance limits independently of the direction around the ring (the clockwise direction, or the anti-clockwise direction).

7 Performance objectives

The ESR, SESR and BBER values given in Table 3 are 50% of the G.828 [10] values for paths in order to provide some margin for maintenance purposes.

Table 3a/M.2101 – Performance objectives for end-to-end international paths

Rate (kbit/s) Parameter	1664 (VC-11)	2240 (VC-12)	6848 (VC-2)	48 960 (VC-3)	150 336 (VC-4)	601 344 (VC-4-4c)	2 405 376 (VC-4-16c)	9 621 504 (VC-4-64c)
Blocks/second	2000	2000	2000	8000	8000	8000	8000	FFS
ESR % of time	0.5	0.5	0.5	1.0	2.0	NA	NA	NA
SESR % of time	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
SEPI events/s (Note)	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}	1×10^{-4}
BBER	2.5×10^{-5}	2.5×10^{-5}	2.5×10^{-5}	2.5×10^{-5}	5×10^{-5}	5×10^{-5}	5×10^{-5}	5×10^{-5}
NOTE – The use of SEPI and limits for maintenance are under study. For VC-4-4/16c, each VC-4 is transmitted 8000 times per second. Because each VC-4 is not evaluated separately, the total number of monitored blocks is still 8000. VC-4-64c may use enhanced EDCs and is FFS. NA Not applicable for this ITU-T Recommendation.								

Table 3b/M.2101 – Performance objectives for end-to-end international multiplex sections

Rate (kbit/s)	STM-0	STM-1	STM-4	STM-16	STM-64
Blocks/second	64 000	192 000	768 000	3 072 000	12 288 000
ESR % of time	1.0	2.0	NA	NA	NA
SESR % of time	0.1	0.1	0.1	0.1	0.1
BBER	2.5×10^{-5}	5×10^{-5}	5×10^{-5}	5×10^{-5}	5×10^{-5}
NA Not applicable for this ITU-T Recommendation.					

For this ITU-T Recommendation SDH signals are evaluated end-to-end such that the ES, BBE and SES event definitions are in accordance with ITU-T Recommendation G.828 [10] for paths. Each Virtual Container (VC) termination point will calculate the ES, BBE and SES counts for the end-to-end VC. For multiplex sections, ES, BBE and SES event definitions are in accordance with ITU-T Recommendation G.829 [11].

End-to-end performance over any trail or connection can only be calculated from whatever signal (e.g. VC or STM) whose source and sink points coincide with the ends chosen for the measurement. Aggregation of performance measurements of trails operating in tandem should only be used where there is no VC or STM source to sink measurement possible. This situation may occur, for example, where VC-1s operating in tandem have been used to make up the full end-to-end path transporting N times 64 kbit/s or primary rate PDH signals. In this case, the PDH Path Overhead evaluated results will provide a better guide to the end-to-end error performance of the path.

A PDH signal transported by an SDH container is evaluated end-to-end according to ITU-T Recommendation M.2100 [16]. The SDH transport portion is evaluated according to this ITU-T Recommendation. For the case of mixed PDH/SDH Terminated paths, ITU-T Recommendation M.2100 [16] applies (at the PDH bit rate).

In the case where SDH containers are mapped into PDH frames, then this ITU-T Recommendation should be applied. It is noted that in this case, PDH sub-networks may have difficulty meeting the more stringent requirements that this ITU-T Recommendation's SDH path performance limits may

impose. Careful maintenance of PDH sub-networks is required to ensure that the SDH container objectives are met.

See Figure 3 for more information.

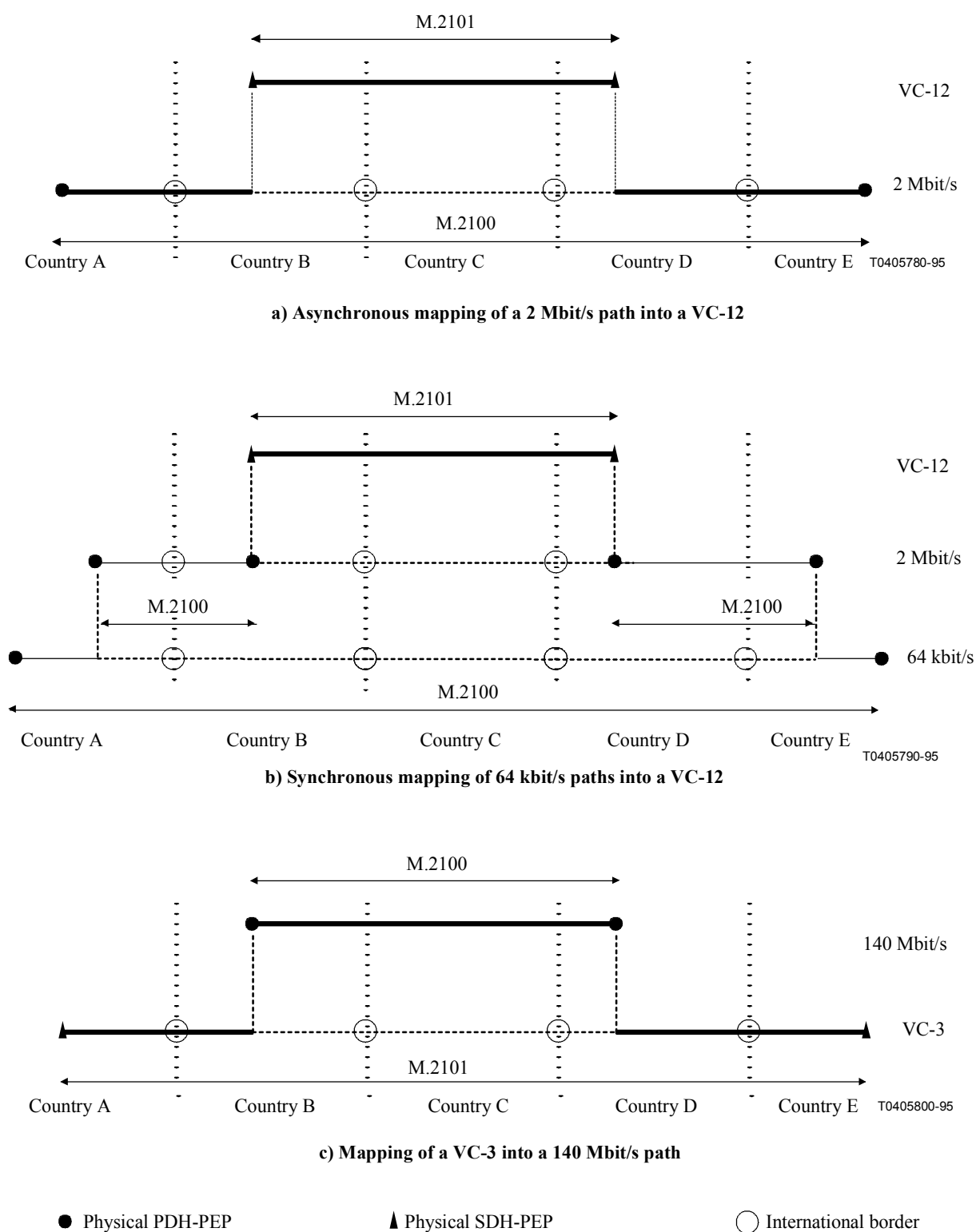


Figure 3/M.2101 – Applications of ITU-T Recommendations M.2100 and M.2101 for mixed SDH and PDH transmission

8 Evaluation of error performance events

This clause addresses the evaluation of the error performance events (ITU-T Recommendation G.828 [10]) using anomalies and defects (see definition in ITU-T Recommendation M.20 [12]).

In-service evaluation is considered in 8.1 and out-of-service evaluation is considered in 8.2.

The treatment of the ES and SES counts during the unavailable state is explained in clause 11.

8.1 Evaluation of ES/BBE/SES events from in-service measurements

8.1.1 Local anomaly and defect indication

The ES, BBE and SES events are evaluated from in-service anomalies and in-service defects relevant to the path terminating equipment at the network level of interest over a one-second-integration period. See Annex B/G.828 [10] for the list of performance-related in-service anomalies.

8.1.2 Remote anomaly and defect indication

Anomalies and defects detected by section and path terminating equipment are reported to the far-end terminating equipment every frame (125 μ sec.) using a byte reserved for this purpose in the section and path overhead. Therefore, the in-service anomalies and defects described in G.828 [10] are available at the terminating equipment for the transmitted direction as well as the received direction.

Anomaly and defect event indicators may be processed into ES, BBE and SES events. Tables have been prepared in Annex B for HO and LO Path Layer and the multiplex section layer. Each table in Annex B provides guidance for ES/BBE/SES evaluation criteria as follows:

- Table B.1 for LO Path Layer;
- Table B.2 for HO Path Layer;
- Table B.3 for multiplex section Layer.

Where applicable, return in-service anomaly or defect information from a remote path terminating equipment is included in the tables. This allows, when required, a single-ended bidirectional monitoring capability.

8.2 Out-of-Service (OOS) measurements

In general, OOS measurements are more accurate than IS measurements since they are performed using a deterministic test signal applied to the NNI. This test signal includes payload and framing overhead information which can then be monitored downstream and errors detected. It may be necessary to stress-test the digital path using test signals with a defined range of variable parameters e.g. frequency offset, pulse density, jitter, wander, etc.

ITU-T Recommendation O.181 [20] specifies measuring equipment to assess the error performance of SDH digital paths at NNIs and includes both a transmitter and a receiver for testing. If only PDH tributary testing is required, then O.15x-series ITU-T Recommendation compliant measuring equipment may be used, but the evaluation criteria for ES and SES from anomalies and defects are given in ITU-T Recommendation M.2100 [16]. In some network equipment, an internal pattern generator and/or error detector may be available which can be connected to the PDH adaptation function or used to stimulate and measure an SDH VC-n container. Assessment of error performance using existing ISM PDH and/or SDH capabilities can also be used whether or not the path payload is stimulated.

Each of the above methods can be used per-direction of a path or with a distant loopback applied to make a loop-around test.

9 Performance limits

Performance limits relative to Allocated Performance Objective from a long-term perspective are given in Table 4.

9.1 General

9.1.1 Relationship between performance limits and objectives

The limits in this ITU-T Recommendation are to be used to indicate the need for actions during maintenance and bringing-into-service. A network maintained to these limits should meet the performance objectives specified in ITU-T Recommendations G.828 [10].

The particular parameters measured, the measurement duration, and the limits used for the procedure need not be identical to those used for specifying the performance objectives as long as they result in network performance which meets these objectives. For example, the error performance objectives refer to long periods, such as one month. However, practical considerations demand that maintenance and BIS limits be based on shorter measurement intervals.

Statistical fluctuations in the occurrence of anomalies and defects mean that one cannot be certain that the long-term objectives are met. The limits on the numbers of events and the duration of measurements attempt to ensure that multiplex sections or paths exhibiting unacceptable or degraded performance can be detected. The only way to ensure that a multiplex section or path meets network performance objectives is to evaluate continuous measurement over a long period (i.e. months).

9.1.2 Types of limits

Limits are needed for several maintenance functions as defined in ITU-T Recommendation M.20 [12]. This ITU-T Recommendation provides path and multiplex section limits for three of these functions:

- bringing-into-service;
- keeping the network operational (maintenance);
- system restoration.

System restoration limits are equal to BIS limits.

Limits for commissioning (installation and acceptance) of multiplex sections are not provided in ITU-T Recommendations.

9.1.2.1 BIS tests/limits

When a particular path/section is brought into service, the collection of anomalies and defects for the BIS tests shall be done at the actual termination points of this path/section. See ITU-T Recommendation M.2110 [18] for further information. For newly equipped paths, long-term (e.g. 24 hour) BIS tests should be used. For new paths on existing routes, shorter BIS tests may be sufficient.

9.1.2.2 Maintenance Limits

Once entities have been placed into service, supervision of the network requires additional limits, as described in ITU-T Recommendation M.20 [12]. This supervision is done by in-service performance monitoring. The supervision process involves analysing anomalies and defects detected by maintenance entities to determine if the performance level is normal, degraded, or unacceptable. Thus, degraded and unacceptable performance limits are required. In addition, a limit on performance after intervention (repair) is also required. It may be different from the BIS limit.

9.1.3 Process for calculation of path performance objectives and limits

The following steps shall be followed to obtain path performance limits:

- 1) Identify the bit rate of the path.
- 2) Read the PO for the appropriate bit rate from Table 3 for ES, BBE, SES and SEP:
 $PO_{es} = x\%$
 $PO_{ses} = y\%$
 $PO_{bbe} = z \text{ (ratio)}$
 $PO_{sep} = n \text{ (counts/s)}$
- 3) Identify all PCEs for the entire path, and set N = the total number of PCEs.
- 4) Label the PCEs as PCE_1 to PCE_N as shown in Figure 1.
- 5) Identify the length, d , of each PCE_n [$n = 1$ to N]. The length, d , is either the actual path length or can be estimated by the great circle length between its endpoints multiplied by the appropriate routing factor from Table 1.
- 6) Read the allocation, $a_n\%$, (as a percentage of end-to-end PO) for PCE_n [$n = 1$ to N] from Table 2a. Note that the allocations in Table 2a are maximum values; more stringent values can be used by bi-lateral or multi-lateral agreement.
- 7) Calculate $A\%$, the path allocation, where:

$$A\% = \sum a_n\%; \text{ i.e. } a_1\% + a_2\% + \dots + a_N\%$$

At this point, the BISPO, S1, S2 and DPL values can be calculated according to the procedures in Annex C. For 2-hour, 1-day and 7-day tests BISPO, S1, and S2 values can be read from the tables given in Annex D. UPL default limits can be found in Annex E (see 9.3.1 for a discussion of UPL and DPL).

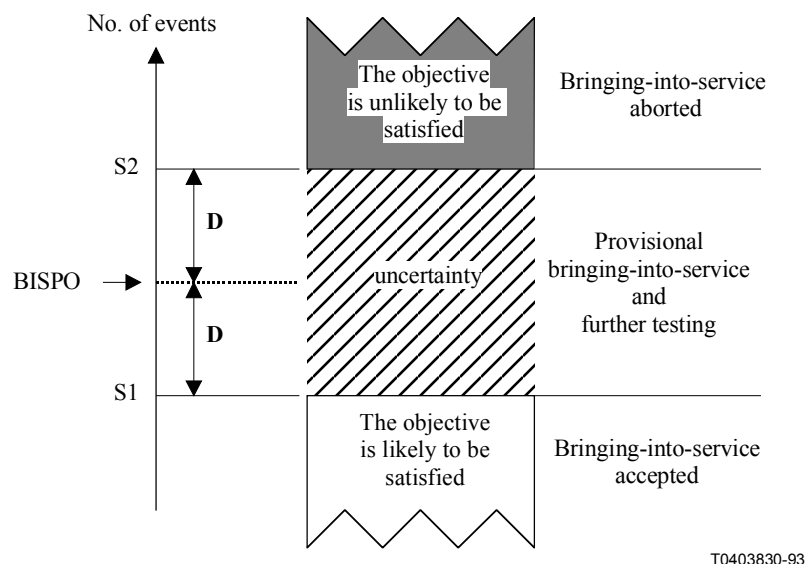
Note that in some cases the BBE S1 limits are non-zero while the ES limits are zero or invalid (i.e. do not provide 95% confidence that the BISPO will be met long term). It is generally suggested that a longer test be used where the ES limits are invalid. In either case, the BBE test cannot be accepted if there is more than 1 ES.

9.2 Performance limits and methodology for BIS

The BIS testing procedure, including how to deal with any period of unavailability during the test, is defined in ITU-T Recommendation M.2110 [18]. This subclause defines the methodology for calculation of BIS performance limits for international paths. The derivation of the limits is a function of a given allocation and the measurement duration, and is based on a pragmatic rule. These limits, which depend on parameters and objectives from ITU-T Recommendations G.828 [10] and G.829 [11], are derived from the values shown in Tables 2 and 3.

The ratio between the APO and the BISPO is called the ageing factor. This factor should be as large as possible to minimize maintenance interventions.

Two limits, S1 and S2, are provided for use in BIS testing, as shown in Figure 4.



$$D = 2\sqrt{\text{BISPO}}$$

Figure 4/M.2101 – Bringing-into-service limits and conditions

If the test result is less than or equal to the S1 limit, the entity can be brought into service with some confidence. If the performance is between the two limits, further testing is necessary and the entity can only be provisionally accepted. Corrective action is required if the performance is worse than the second limit S2.

The ageing factor for paths is 0.5 times the APO and the ageing factor for multiplex sections is 0.1 times the APO except for SES where it is also 0.5 times the APO.

Continuous in-service monitoring is required to provide sufficient confidence in the long-term performance.

9.2.1 BIS limit values

By application of the methodology of 9.1.3, the performance limits for BIS are calculated according to the allocation and the testing duration. BIS tests described in ITU-T Recommendation M.2110 [18] are:

- 2-hour limits;
- 24-hour limits;
- 7-day limits.

9.3 Performance limits for maintenance

Once entities have been placed into service, the supervision of the network requires additional limits, as described in ITU-T Recommendation M.20 [12]. The supervision process involves analysing anomalies and defects detected by maintenance entities to determine the performance level. The maintenance procedures are defined in ITU-T Recommendation M.2120 [19].

9.3.1 Performance levels and limits

According to ITU-T Recommendation M.20 [12], an entity can be in a limited number of predefined conditions depending on its performance. These conditions are called performance levels, and are the Unacceptable Performance Level, the Degraded Performance Level and the Acceptable Performance Level. The boundaries between the performance levels are called performance limits. The performance limits are a function of the APO as follows:

- UP Limit $\geq 10 \times \text{APO}$;
- DP Limit = $0.75 \times \text{APO}$ (path);
- DP Limit = $0.50 \times \text{APO}$ (multiplex section).

In the case of testing performance after repair, a special threshold, "Performance After Repair", is used (see ITU-T Recommendations M.34 [14] and M.2110 [18]) where:

- Performance After Repair = $0.1 \times \text{APO}$ (multiplex section) for ES and BBE;
- Performance After Repair = $0.5 \times \text{APO}$ (multiplex section) for SES and SEP;
- Performance After Repair = $0.5 \times \text{APO}$ (path).

Performance levels are bounded by UP and DP Limits. The "Performance After Repair" and BIS thresholds are included in the ACCEPTABLE range but are not boundaries between performance levels. The PO is contained within the DEGRADED range but is also not a boundary. These principles are illustrated in Table 4.

Table 4/M.2101 – Performance levels and limits (ES, BBE, SES and SEP) relative to long-term APO (> 1 month) performance ranges

Multiplex sections		Paths	
Limit (Relative to APO)	Performance level range	Limit (Relative to APO)	Performance level range
BIS/Performance after repair (ES & BBE) 0.10	ACCEPTABLE ($< 0.5 \text{ APO}$)	BIS/Performance after repair 0.50	ACCEPTABLE ($< 0.75 \text{ APO}$)
BIS/Performance after repair (SES & SEP) (Note) 0.5	ACCEPTABLE ($< 0.5 \text{ APO}$)		
Performance objective 1.00	DEGRADED (≥ 0.50 to $< 10 \text{ APO}$)	Performance objective 1.00	DEGRADED (≥ 0.75 to $< 10 \text{ APO}$)
	UNACCEPTABLE ($\geq 10 \text{ APO}$)		UNACCEPTABLE ($\geq 10 \text{ APO}$)
NOTE – SEP thresholds are for 7-day tests only. The use of SEP and limits for maintenance are under study.			

9.3.2 Thresholds

When a limit is given a specific value in terms of ES, BBE and/or SES, the ES, BBE and/or SES value is called a threshold. Each threshold will have an associated measurement duration.

9.3.2.1 Use of thresholds

The general strategy for the use of performance monitoring information and thresholds is described in ITU-T Recommendations M.20 [12] and M.34 [14]. These thresholds and monitoring information will be reported to operations systems via the TMN for both real time and longer term analysis. When thresholds of unacceptable or degraded performance levels are reached, maintenance action should be initiated independently of the performance measurement. Other thresholds may be used for maintenance and longer term quality analysis. The operations systems will use real time processing to assign maintenance priorities to these threshold crossings and information, using the performance supervision process described in ITU-T Recommendation M.20 [12].

9.3.2.2 Types of thresholds

There are two types of thresholds according to the monitoring duration T1 or T2.

Thresholds associated with a T1 evaluation period

The monitoring duration T1 is fixed to a 15-minute value and ES, BBE and SES are counted over this period. The T1 period is to assist in detection of transition to or from the unacceptable performance level.

A threshold report occurs when an ES, BBE or SES threshold is exceeded. The reset threshold report, which is an optional feature, occurs when the number of ES, BBE and SES is lower than or equal to the reset threshold. Those principles are explained in ITU-T Recommendation M.2120 [19].

Thresholds associated with a T2 evaluation period

The monitoring duration T2 is fixed to a 24-hour value. The T2 period is to assist in detection of transition to the degraded performance level.

A threshold report occurs when an ES, BBE or SES threshold is exceeded over the period of time T2 as explained in ITU-T Recommendation M.2120 [19].

9.3.2.3 Threshold values

ES, BBE and SES thresholds should be programmable to suit specific operating requirements. In particular, the need for iterative adjustment (with operational experience) of the threshold is seen as a likely requirement.

The default unacceptable performance thresholds for the 15-minute evaluation periods are given in Table E.1 for VC-1, 2, 3, 4 and STM-1, 4, 16, and 64 (see Annex E).

The degraded performance thresholds for the 24-hour evaluation period are the responsibility of each network operator. $0.75 \times \text{APO}$ values are suggested for paths. $0.5 \times \text{APO}$ values are suggested for multiplex sections.

9.4 Long-term quality monitoring/measurement

Performance monitoring history should be kept for at least one year (suggested) by the management system.

10 Effects of timing impairments on error performance

Jitter and wander are timing impairments related to the fluctuations in the timing signal. Limits for jitter and wander are defined in ITU-T Recommendation G.825 [7]. Those limits are fixed in such a way that a given level of jitter could be applied to the input of a network equipment without producing errors or excessive jitter at its output.

Therefore, for maintenance purposes, the error performance requirements are sufficient to deal with those timing impairments.

11 Availability and unavailability

11.1 Criteria for entry/exit to/from the Unavailable State

A period of unavailable time begins at the onset of ten consecutive SES events. These ten seconds are considered to be part of unavailable time. A new period of available time begins at the onset of ten consecutive non-SES events. These ten seconds are considered to be part of available time. Note that the availability criterion is defined for a single direction only. This definition is aligned with the corresponding definition in A.1/G.828 [10]. The availability criterion for a bidirectional path,

defined in A.2/G.828, is used in the performance data collection and evaluation process for long-term network performance characterization. This ITU-T Recommendation deals with the performance data collection and evaluation process only for BIS and maintenance purposes; this ITU-T Recommendation therefore does not use the bidirectional definition.

To determine the entry/exit to/from unavailability, the collection of SES is necessary. See ITU-T Recommendation G.784 [4] for implementation of SES collection.

11.2 Inhibiting performance monitoring during unavailable time

During unavailable time, the count of performance events is inhibited. When only one direction of a bidirectional path is unavailable, the count of performance events is inhibited for this direction and continues for the other direction. Figure 5 illustrates the rules for determining the unavailable second parameter and for inhibiting other parameter counts. Reading down and left to right, the first row represents the error condition and shows momentary and persistent conditions. It indicates if an error condition exists (Y) or not (N). Error conditions include anomalies and defects as shown. Proceeding in a similar manner, the latter three rows show the procedures for calculating path unavailable seconds, real-time and adjusted real-time parameter counts.

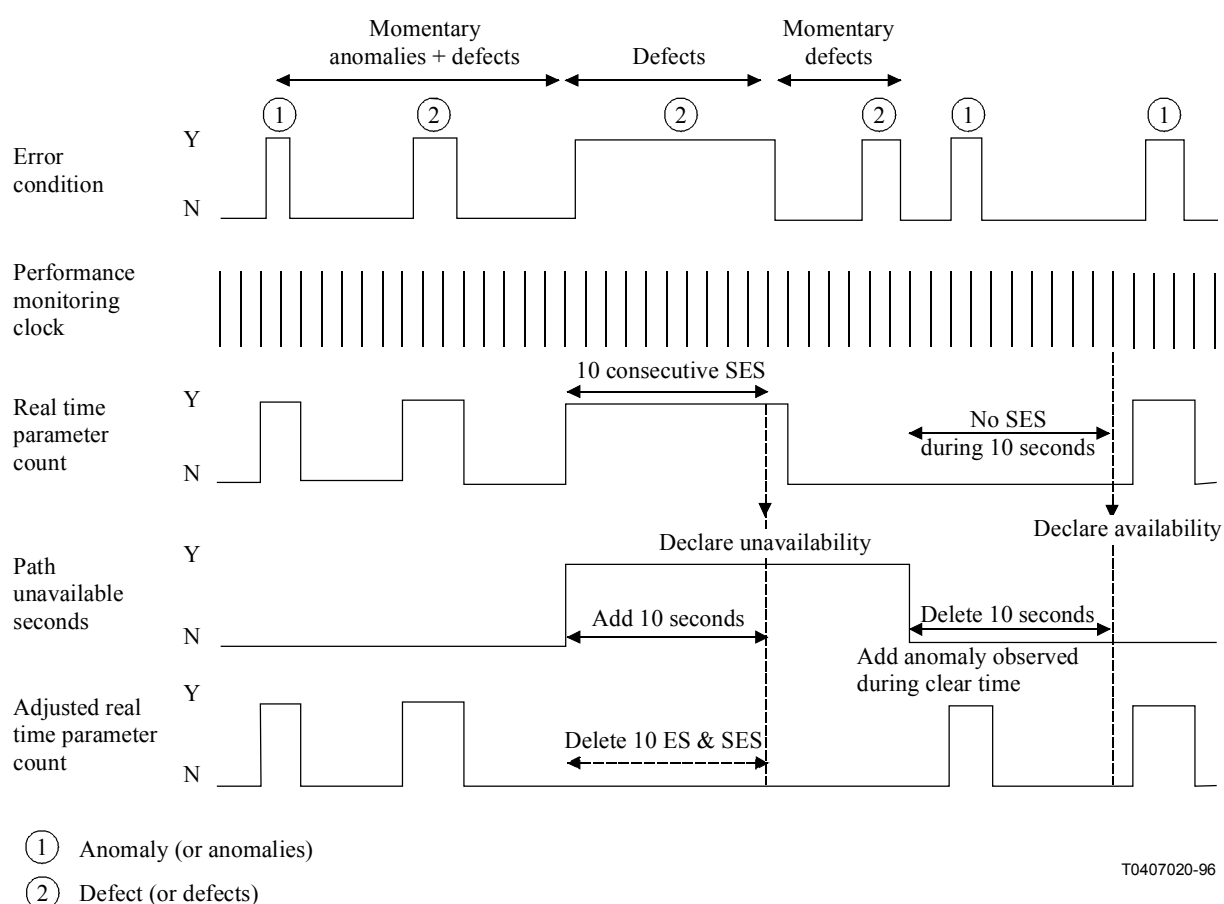


Figure 5/M.2101 – Illustration of performance monitoring inhibiting during unavailable time

This figure shows the correction to the unavailable counter, and the rules for deleting and adding increments in time in the unavailable second counter. It also shows the count of anomalies during the clearing time interval.

Note that the signal condition transition, or declaration instant of a defect or anomaly condition is independent of the performance monitoring clock one-second boundaries.

11.3 Unavailability limits

Unavailability limits for maintenance are under study. In general, any transition to the unavailable state should be unacceptable for BIS. For radio and satellite systems however, unavailable periods due to natural phenomena (e.g. rain fade) may be acceptable.

ANNEX A

Example applications of path allocation (A%) from Table 2a

This annex provides an example showing the application of path allocation (A%) as described in clause 6.

Example: An SDH path

T1	BC1	T2	SC1	T3	BC2	T4

T Terminating or transit IPCE

BC Border crossing ICPCE

SC Submarine cable ICPCE

T1, T4 IPCE (Terminating) 1000 km – 2500 km $2 \times 4.0\% = 8.0\%$

T2 IPCE (Transit) 500 km – 1000 km $1 \times 3.0\% = 3.0\%$

T3 IPCE (Transit) 400 km – 500 km $1 \times 2.0\% = 2.0\%$

SC1 ICPCE (Optical undersea cable) $1 \times 2.5\% = 2.5\%$

BC1, BC2 ICPCE (Terrestrial) $2 \times 0.3\% = 0.6\%$

Total SDH path allocation = 16.1%

ANNEX B

In-service ES, BBE and SES event evaluation criteria

In addition to path performance monitoring, this annex covers Tandem Connection Monitoring (TCM) as shown in Tables B.1 and B.2. VC-n and TC-n trails are equivalent from a performance perspective. The established rules for VC-n apply also to TC-n. Further details are given in ITU-T Recommendations G.707 [2] and G.803 [5].

**Table B.1/M.2101 – In-service ES, BBE and SES event evaluation criteria
for the LO path layer**

			ES/SES event evaluation criteria (Anomalies and defects in 1 second)			
Virtual container type	Path/TC overhead available to derive anomaly and defect information		Thresholds and mapping for anomalies and defects in 1 second	Interpretation for Receive direction	Interpretation for Send direction	Remarks
VC-11, VC-12, VC-2,	Path	TC				
	H4	H4	1 HP-LOM	ES + SES		
	V1, V2	V1, V2	1 TU-AIS	ES + SES		
	V1, V2	V1, V2	1 TU-LOP	ES + SES		
	J2	N2	1 LP/LPTC-TIM	ES + SES		
	V5	N2	1 LP/LPTC-UNEQ	ES + SES		
	NA	N2	1 LPTC-LTC	ES + SES		
	V5	N2	1 BIP-2 error	ES		
	V5	N2	600 "BIP-2" errors	ES + SES		
	V5	N2	# of "BIP-2" errors	# of BBE		"BIP-2" error ≡ "BIP-2" ≠ 0
	V5	N2	1 LP/LPTC-REI		ES	
	V5	N2	600 "LP/LPTC REI>0"		ES + SES	
	V5	N2	# of "LP/LPTC REI>0"		# of BBE	
	V5	N2	1 LP/LPTC-RDI		ES + SES	
VC-3	H1, H2	H1, H2	1 TU-AIS	ES + SES		
	H1, H2	H1, H2	1 TU-LOP	ES + SES		
	J1	N1	1 LP/LPTC-TIM	ES + SES		
	C2	N1	1 LP/LPTC-UNEQ	ES + SES		
	NA	N1	1 LPTC-LTC	ES + SES		
	B3	N1/B3	1 BIP-8 error	ES		
	B3	N1/B3	2 400 "BIP-8" errors	ES + SES		"BIP-8" error ≡ "BIP-8" ≠ 0
	G1	N1	1 LP/LPTC-REI		ES	
	G1	N1	2 400 "LP/LPTC REI>0"		ES + SES	
	G1	N1	1 LP/LPTC RDI		ES + SES	
	B3	N1/B3	# of "BIP-8" errors	# of BBE		(Note)
	G1	N1	# of "LP/LPTC REI>0"		# of BBE	(Note)
NA Not applicable.						
NOTE – BBE not counted during a second which is declared to be an SES.						

**Table B.2/M.2101 – In-service ES, SES and BBE event evaluation criteria
for the HO path layer**

			ES/SES event evaluation criteria (Anomalies and defects in 1 second)			
Virtual container type	Path overhead available to derive anomaly and defect information		Thresholds and mapping for anomalies and defects in 1 second	Interpretation for Receive direction	Interpretation for Send direction	Remarks
VC-3, VC-4 and VC-4-4C and VC-4-16c and VC-4-64c	Path	TC	1 AU-AIS	ES + SES		
	H1, H2	H1, H2	1 AU-LOP	ES + SES		
	H1, H2	H1, H2	1 HP/HPTC-TIM	ES + SES		
	J1	N1	1 HP/HPTC-UNEQ	ES + SES		
	C2	N1	1 HP/HPTC-LTC	ES + SES		
	NA	N1	1 "BIP-8" error	ES		"BIP-8" error
	B3	N1/B3	2 400 "BIP-8" errors	ES + SES		≡ "BIP-8" ≠ 0
	B3	N1/B3	# of "BIP-8" errors	# of BBE		(Note)
	G1	N1	1 "HP/HPTC-REI>0"		ES	
	G1	N1	2 400 "HP/HPTC REI>0"		ES + SES	
	G1	N1	1 HP/HPTC-RDI		ES + SES	
	G1	N1	# of "HP/HPTC REI>0"		# of BBE	(Note)
NA Not applicable.						
NOTE – BBE not counted during a second which is declared to be an SES.						

**Table B.3/M.2101 – In-service ES, SES and BBE event evaluation criteria
for the section layer**

		ES/SES event evaluation criteria (Anomalies and defects in 1 second)			
Section type and STM level	Section overhead available to derive anomaly and defect information	Thresholds and mapping for anomalies and defects in 1 second	Interpretation for Receive direction	Interpretation for Send direction	Remarks
MS-STM-0,	B2	1 BIP-1 error	ES		
	B2	# of BIP-1 errors	# of BBE		
	M1	1 MS-AIS	ES + SES		
	M1	1 MS-REI > 0		ES	
	M1	ΣMS-REI count		# of BBE	MS-REI contains
	M1	1 MS-RDI		ES + SES	FE BIP-1 count/frame
MS-STM-1, MS-STM-4, and MS-STM-16 MS-STM-64	B2	1 BIP-1 error	ES		
	B2	# of BIP-1 errors	# of BBE		
	K1, K2	1 MS-AIS	ES + SES		
	M1	1 MS-REI > 0		ES	
	M1	ΣMS-REI count		# of BBE	MS-REI contains
	K2	1 MS-RDI		ES + SES	FE BIP-1 count/frame
MS-STM-0	B2	a BIP-1	ES + SES		SES BBE thresholds for
	M1	a MS-REI		ES + SES	STM-0 are under study
MS-STM-1	B2	28 800 BIP-1	ES + SES		
	M1	28 800 ΣMS-REI		ES + SES	
MS-STM-4	B2	192 000 BIP-1	ES + SES		
	M1	192 000 ΣMS-REI		ES + SES	
MS-STM-16 MS-STM-64	B2	b BIP-1	ES + SES		SES and BBE thresholds
	M1	b ΣMS-REI		ES + SES	are under study
NOTE – BBE not counted during a second which is declared to be an SES.					

ANNEX C

Calculation of objectives and limits for ES, BBE and SES

Using this annex requires that the allocation (A%) and PO_{es} (x%), PO_{ses} (y%) and PO_{bbe} (z) have been determined in 9.1.3. The steps for calculating ES, BBE and SES limits are as follows:

Note that if any PCE within a path is changed, then the whole calculation process must be repeated, since the S1 and S2 values are non-linear.

- 1) Determine the required Test Period, (TP) where TP = 15 min., 1 hour, 2 hours, 24 hours, or 7 days. Express TP in seconds, e.g. TP = 900 seconds for a 15-minute test.
- 2) Calculate the APO (Allocated Performance Objective) counts for ES and SES required from the information already obtained:

$$APO_{es} = A \times PO_{es} \times TP \div 10\,000 \text{ (convert A\% and PO\% to ratio)}$$

$$APO_{ses} = A \times PO_{ses} \times TP \div 10\,000 \text{ (convert A\% and PO\% to ratio)}$$

For multiplex sections, go to step 3m), for paths continue

- 3p) Calculate the APO counts for BBE required from the information already obtained plus the block size from Table 3:

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 2\,000 \div 100 \text{ (convert A\% to ratio – VC-1 \& 2)}$$

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 8\,000 \div 100 \text{ (convert A\% to ratio – VC-3 \& 4 and VC-4-Xc)}$$

- 4p) Calculate the BISPOs for the path:

$$BISPO_{es} = \frac{APO_{es}}{2}$$

$$BISPO_{ses} = \frac{APO_{ses}}{2}$$

$$BISPO_{bbe} = \frac{APO_{bbe}}{2}$$

NOTE 1 – If the unrounded BISPO is < 3 for a given test duration, the test will not provide the 95% confidence that the path will meet the long-term objectives of ITU-T Recommendation G.828 [10]. A longer test is recommended if this is the case. If the unrounded BISPO is < 3 for a 7-day test, the path may be brought into service with a pragmatic S1 limit of 0. SEP has only a 7-day test.

- 5p) Calculate S1 and S2 values:

$$D_{es} = 2\sqrt{BISPO_{es}}$$

$$S1_{es} = BISPO_{es} - D_{es}$$

$$S2_{es} = BISPO_{es} + D_{es}$$

$$D_{ses} = 2\sqrt{BISPO_{ses}}$$

$$S1_{ses} = BISPO_{ses} - D_{ses}$$

$$S2_{ses} = BISPO_{ses} + D_{ses}$$

$$D_{bbe} = 2\sqrt{BISPO_{bbe}}$$

$$S1_{bbe} = BISPO_{bbe} - D_{bbe}$$

$$S2_{bbe} = BISPO_{bbe} + D_{bbe}$$

Round all S1 and S2 values to the nearest integer value ≥ 0 .

- 6p) Calculate Degraded Performance Limit thresholds for the path:

$$DPL_{es} = 0.75 \times APO_{es} [TP = 86\,400]$$

$$DPL_{ses} = 0.75 \times APO_{ses} [TP = 86\,400]$$

$$DPL_{bbe} = 0.75 \times APO_{bbe} [TP = 86\,400]$$

- 7p) Read the Unacceptable Performance Limit thresholds from Annex E for the path bit rate. These are pragmatic values.

STOP for path

- 3m) Calculate the APO counts for BBE required from the information already obtained plus the block size from Table 3:

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 64\,000 \div 100 \text{ (convert A\% to ratio – STM-0)}$$

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 192\,000 \div 100 \text{ (convert A\% to ratio – STM-1)}$$

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 768\,000 \div 100 \text{ (convert A\% to ratio – STM-4)}$$

$$APO_{bbe} = A \times PO_{bbe} \times TP \times 3\,072\,000 \div 100 \text{ (convert A\% to ratio – STM-16)}$$

NOTE 2 – STM-64 is still under study.

- 4m) Calculate the BISPOs for the multiplex section:

$$BISPO_{es} = \frac{APO_{es}}{10}$$

$$BISPO_{ses} = \frac{APO_{ses}}{2}$$

$$BISPO_{bbe} = \frac{APO_{bbe}}{10}$$

NOTE 3 – If the unrounded BISPO is < 3 , for a given test duration, the test will not provide the 95% confidence that the path will meet the long-term objectives of ITU-T Recommendation G.828 [10]. A longer test recommended if this is the case. If the unrounded BISPO is < 3 for a 7-day test, the multiplex section may be brought into service with a pragmatic S1 limit of 0.

- 5m) Calculate S1 and S2 values:

$$D_{es} = 2\sqrt{BISPO_{es}}$$

$$S1_{es} = BISPO_{es} - D_{es}$$

$$S2_{es} = BISPO_{es} + D_{es}$$

$$D_{ses} = 2\sqrt{BISPO_{ses}}$$

$$S1_{ses} = BISPO_{ses} - D_{ses}$$

$$S2_{ses} = BISPO_{ses} + D_{ses}$$

$$D_{bbe} = 2\sqrt{BISPO_{bbe}}$$

$$S1_{bbe} = BISPO_{bbe} - D_{bbe}$$

$$S2_{bbe} = BISPO_{bbe} + D_{bbe}$$

Round all S1 and S2 values to the nearest integer value ≥ 0 .

- 6m) Calculate Degraded Performance Limit thresholds for the multiplex section:

$$DPL_{es} = 0.5 \times APO_{es} [TP = 86\ 400]$$

$$DPL_{ses} = 0.5 \times APO_{ses} [TP = 86\ 400]$$

$$DPL_{bbe} = 0.5 \times APO_{bbe} [TP = 86\ 400]$$

- 7m) Read the Unacceptable Performance Limit thresholds from Annex E for the multiplex section bit rate. These are pragmatic values.

ANNEX D

Allocated performance objectives and limits for ES, BBE, SES and SEP

See Tables D.1 to D.14.

Table D.1/M.2101 – Allocated ES performance objectives and limits for VC-1 and VC-2; PO = 0.5%; BISPO = 0.5 × APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	2 hrs	BISPO	0	0	0	0	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	4	
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	
		S2	0	1	1	2	2	2	3	3	4	4	4	4	5	5	5	6	6	6	7	7	7	7	
	1 Day	BISPO	0	1	2	4	6	9	11	13	15	17	19	22	24	26	28	30	32	35	37	39	41	43	
		S1	X	X	X	0	1	3	4	6	7	9	11	12	14	16	17	19	21	23	25	26	28	30	
		S2	2	3	5	8	12	15	17	20	23	26	28	31	34	36	39	41	44	46	49	51	54	56	
	7 Days	BISPO	3	8	15	30	45	60	76	91	106	121	136	151	166	181	197	212	227	242	257	272	287	302	
		S1	0	2	7	19	32	45	58	72	85	99	113	127	141	155	169	183	197	211	225	239	253	268	
		S2	7	13	23	41	59	76	93	110	126	143	159	176	192	208	225	241	257	273	289	305	321	337	
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	4	4	4	4	5	5	5	5	5	5	6	6	6	6	6	6	7	7	7	7	7	8	
		S1	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	
		S2	8	8	8	8	9	9	9	10	10	10	10	11	11	11	11	11	12	12	12	12	13	13	13
	1 Day	BISPO	45	48	50	52	54	56	58	60	63	65	67	69	71	73	76	78	80	82	84	86	89	91	
		S1	32	34	36	37	39	41	43	45	47	49	51	52	54	56	58	60	62	64	66	68	70	72	
		S2	59	61	64	66	69	71	74	76	78	81	83	86	88	91	93	95	98	100	103	105	107	110	
	7 Days	BISPO	318	333	348	363	378	393	408	423	438	454	469	484	499	514	529	544	559	575	590	605	620	635	
		S1	282	296	310	325	339	353	368	382	397	411	425	440	454	469	483	498	512	527	541	556	570	585	
		S2	353	369	385	401	417	433	449	465	480	496	512	528	544	559	575	591	607	622	638	654	670	685	
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	8	8	8	8	8	9	9	9	9	9	10	10	10	10	10	10	11	11	11	11	11		
		S1	2	2	2	3	3	3	3	3	3	3	3	3	4	4	4	4	4	4	4	4	5		
		S2	13	14	14	14	14	15	15	15	15	15	16	16	16	16	17	17	17	17	18	18	18		
	1 Day	BISPO	93	95	97	99	102	104	106	108	110	112	114	117	119	121	123	125	127	130	132	134	136		
		S1	74	76	77	79	81	83	85	87	89	91	93	95	97	99	101	103	105	107	109	111	113		
		S2	112	115	117	119	122	124	126	129	131	134	136	138	141	143	145	148	150	152	155	157	159		
	7 Days	BISPO	650	665	680	696	711	726	741	756	771	786	801	816	832	847	862	877	892	907	922	937	953		
		S1	599	614	628	643	657	672	686	701	716	730	745	759	774	789	803	818	832	847	862	876	891		
		S2	701	717	733	748	764	780	795	811	827	842	858	874	889	905	921	936	952	967	983	999	1014		
X Invalid test: A longer test period is required.																									

Table D.2/M.2101 – Allocated ES performance objectives and limits for VC-3; PO = 1.0%; BISPO = 0.5 × APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	2 hrs	BISPO	0	0	0	1	1	1	2	2	3	3	3	4	4	4	5	5	5	6	6	6	7	7	
		S1	X	X	X	X	X	X	X	X	X	X	X	0	0	0	0	0	1	1	1	1	1	2	2
		S2	1	1	2	2	3	4	4	5	6	6	7	7	8	8	9	10	10	11	11	12	12	13	
	1 Day	BISPO	1	2	4	9	13	17	22	26	30	35	39	43	48	52	56	60	65	69	73	78	82	86	
		S1	X	X	0	3	6	9	12	16	19	23	26	30	34	37	41	45	49	52	56	60	64	68	
		S2	3	5	8	15	20	26	31	36	41	46	51	56	61	66	71	76	81	86	91	95	100	105	
	7 Days	BISPO	6	15	30	60	91	121	151	181	212	242	272	302	333	363	393	423	454	484	514	544	575	605	
		S1	1	7	19	45	72	99	127	155	183	211	239	268	296	325	353	382	411	440	469	498	527	556	
		S2	11	23	41	76	110	143	176	208	241	273	305	337	369	401	433	465	496	528	559	591	622	654	
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	8	8	8	9	9	9	10	10	10	11	11	12	12	12	13	13	13	14	14	14	15	15	
		S1	2	2	3	3	3	3	3	4	4	4	4	5	5	5	6	6	6	6	7	7	7	7	
		S2	13	14	14	15	15	15	16	16	17	17	18	18	19	19	20	20	21	21	22	22	22	23	
	1 Day	BISPO	91	95	99	104	108	112	117	121	125	130	134	138	143	147	151	156	160	164	168	173	177	181	
		S1	72	76	79	83	87	91	95	99	103	107	111	115	119	123	127	131	135	139	143	147	151	155	
		S2	110	115	119	124	129	134	138	143	148	152	157	162	166	171	176	180	185	190	194	199	204	208	
	7 Days	BISPO	635	665	696	726	756	786	816	847	877	907	937	968	998	1028	1058	1089	1119	1149	1179	1210	1240	1270	
		S1	585	614	643	672	701	730	759	789	818	847	876	905	935	964	993	1023	1052	1081	1111	1140	1169	1199	
		S2	685	717	748	780	811	842	874	905	936	967	999	1030	1061	1092	1123	1155	1186	1217	1248	1279	1310	1341	
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	15	16	16	17	17	17	18	18	18	19	19	19	20	20	21	21	21	22	22	22	23		
		S1	8	8	8	8	9	9	9	10	10	10	10	11	11	11	11	12	12	12	13	13	13		
		S2	23	24	24	25	25	26	26	26	27	27	28	28	29	29	30	30	30	31	31	32	32		
	1 Day	BISPO	186	190	194	199	203	207	212	216	220	225	229	233	238	242	246	251	255	259	264	268	272		
		S1	159	163	167	171	175	179	183	187	191	195	199	203	207	211	215	219	223	227	231	235	239		
		S2	213	218	222	227	232	236	241	245	250	255	259	264	268	273	278	282	287	291	296	301	305		
	7 Days	BISPO	1300	1331	1361	1391	1421	1452	1482	1512	1542	1572	1603	1633	1663	1693	1724	1754	1784	1814	1845	1875	1905		
		S1	1228	1258	1287	1316	1346	1375	1405	1434	1464	1493	1523	1552	1582	1611	1641	1670	1700	1729	1759	1788	1818		
		S2	1372	1404	1435	1466	1497	1528	1559	1590	1621	1652	1683	1714	1745	1776	1807	1838	1869	1900	1931	1961	1992		
X Invalid test: A longer test period is required.																									

Table D.3/M.2101 – Allocated ES performance objectives and limits for VC-4; PO = 2.0%; BISPO = 0.5 × APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	0	0	1	1	2	3	4	4	5	6	6	7	8	9	9	10	11	12	12	13	14	14
		S1	X	X	X	X	X	X	0	0	1	1	1	2	2	3	3	4	4	5	5	6	6	7
		S2	1	2	2	4	5	6	7	8	10	11	12	13	14	15	15	16	17	18	19	20	21	22
	1 Day	BISPO	2	4	9	17	26	35	43	52	60	69	78	86	95	104	112	121	130	138	147	156	164	173
		S1	X	X	3	9	16	23	30	37	45	52	60	68	76	83	91	99	107	115	123	131	139	147
		S2	4	8	15	26	36	46	56	66	76	86	95	105	115	124	134	143	152	162	171	180	190	199
	7 Days	BISPO	12	30	60	121	181	242	302	363	423	484	544	605	665	726	786	847	907	968	1028	1089	1149	1210
		S1	5	19	45	99	155	211	268	325	382	440	498	556	614	672	730	789	847	905	964	1023	1081	1140
		S2	19	41	76	143	208	273	337	401	465	528	591	654	717	780	842	905	967	1030	1092	1155	1217	1279
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	15	16	17	17	18	19	19	20	21	22	22	23	24	24	25	26	27	27	28	29	30	30
		S1	7	8	8	9	10	10	11	11	12	12	13	13	14	15	15	16	16	17	17	18	19	19
		S2	23	24	25	26	26	27	28	29	30	31	32	33	34	34	35	36	37	38	39	40	40	41
	1 Day	BISPO	181	190	199	207	216	225	233	242	251	259	268	276	285	294	302	311	320	328	337	346	354	363
		S1	155	163	171	179	187	195	203	211	219	227	235	243	251	259	268	276	284	292	300	308	317	325
		S2	208	218	227	236	245	255	264	273	282	291	301	310	319	328	337	346	355	365	374	383	392	401
	7 Days	BISPO	1270	1331	1391	1452	1512	1572	1633	1693	1754	1814	1875	1935	1996	2056	2117	2177	2238	2298	2359	2419	2480	2540
		S1	1199	1258	1316	1375	1434	1493	1552	1611	1670	1729	1788	1847	1906	1966	2025	2084	2143	2202	2262	2321	2380	2439
		S2	1341	1404	1466	1528	1590	1652	1714	1776	1838	1900	1961	2023	2085	2147	2209	2271	2332	2394	2456	2518	2579	2641
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	31	32	32	33	34	35	35	36	37	37	38	39	40	40	41	42	42	43	44	45	45	
		S1	20	20	21	22	22	23	23	24	25	25	26	26	27	28	28	29	29	30	31	31	32	
		S2	42	43	44	45	45	46	47	48	49	50	51	51	52	53	54	55	56	56	57	58	59	
	1 Day	BISPO	372	380	389	397	406	415	423	432	441	449	458	467	475	484	492	501	510	518	527	536	544	
		S1	333	341	349	358	366	374	382	390	399	407	415	423	432	440	448	456	465	473	481	489	498	
		S2	410	419	428	437	446	455	465	474	483	492	501	510	519	528	537	546	555	564	573	582	591	
	7 Days	BISPO	2601	2661	2722	2782	2843	2903	2964	3024	3084	3145	3205	3266	3326	3387	3447	3508	3568	3629	3689	3750	3810	
		S1	2499	2558	2617	2677	2736	2795	2855	2914	2973	3033	3092	3152	3211	3270	3330	3389	3449	3508	3568	3627	3687	
		S2	2703	2764	2826	2888	2949	3011	3072	3134	3196	3257	3319	3380	3442	3503	3565	3626	3688	3749	3811	3872	3934	
X Invalid test: A longer test period is required.																								

Table D.4/M.2101 – Allocated ES performance objectives and limits for STM-0; PO = 1.0%; BISPO = 0.1 × APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	2 hrs	BISPO	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		S2	0	0	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	4	4	4
	1 Day	BISPO	0	0	1	2	3	3	4	5	6	7	8	9	10	10	11	12	13	14	15	16	16	17	
		S1	X	X	X	X	X	0	0	1	1	2	2	3	3	4	5	5	6	6	7	8	8	9	
		S2	1	2	3	4	6	7	8	10	11	12	13	15	16	17	18	19	20	21	22	23	25	26	
	7 Days	BISPO	1	3	6	12	18	24	30	36	42	48	54	60	67	73	79	85	91	97	103	109	115	121	
		S1	0*	0	1	5	10	14	19	24	29	34	40	45	50	56	61	66	72	77	83	88	93	99	
		S2	3	7	11	19	27	34	41	48	55	62	69	76	83	90	96	103	110	116	123	130	136	143	
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	0	0	
		S2	4	4	4	4	4	5	5	5	5	5	5	5	5	6	6	6	6	6	6	6	6	7	
	1 Day	BISPO	18	19	20	21	22	22	23	24	25	26	27	28	29	29	30	31	32	33	34	35	35	36	
		S1	10	10	11	12	12	13	14	14	15	16	16	17	18	19	19	20	21	21	22	23	24	24	
		S2	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	
	7 Days	BISPO	127	133	139	145	151	157	163	169	175	181	187	194	200	206	212	218	224	230	236	242	248	254	
		S1	104	110	116	121	127	132	138	143	149	155	160	166	171	177	183	188	194	200	205	211	216	222	
		S2	150	156	163	169	176	182	189	195	202	208	215	221	228	234	241	247	254	260	267	273	279	286	
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	3	3	3	3	3	3	4	4	4	4	4	4	4	4	4	4	4	4	4	4	5		
		S1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0		
		S2	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	8	9	9	9		
	1 Day	BISPO	37	38	39	40	41	41	42	43	44	45	46	47	48	48	49	50	51	52	53	54	54		
		S1	25	26	26	27	28	29	29	30	31	32	32	33	34	34	35	36	37	37	38	39	40		
		S2	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69		
	7 Days	BISPO	260	266	272	278	284	290	296	302	308	314	321	327	333	339	345	351	357	363	369	375	381		
		S1	228	233	239	245	251	256	262	268	273	279	285	290	296	302	308	313	319	325	331	336	342		
		S2	292	299	305	312	318	324	331	337	344	350	356	363	369	375	382	388	395	401	407	414	420		
X Invalid test: A longer test period is required.																									
* Test values do not provide 95% confidence for meeting the long-term performance. However, since a longer test is not practical, a limit of "0" is used for S1.																									

Table D.5/M.2101 – Allocated ES performance objectives and limits for STM-1; PO = 2.0%; BISPO = 0.1 × APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	0	0	0	0	0	1	1	1	1	1	1	1	2	2	2	2	2	2	2	3	3	3
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		S2	0	1	1	1	2	2	2	3	3	3	4	4	4	4	5	5	5	5	6	6	6	6
	1 Day	BISPO	0	1	2	3	5	7	9	10	12	14	16	17	19	21	22	24	26	28	29	31	33	35
		S1	X	X	X	0	1	2	3	4	5	6	8	9	10	12	13	14	16	17	19	20	21	23
		S2	2	3	4	7	10	12	15	17	19	21	23	26	28	30	32	34	36	38	40	42	44	46
	7 Days	BISPO	2	6	12	24	36	48	60	73	85	97	109	121	133	145	157	169	181	194	206	218	230	242
		S1	0*	0*	5	14	24	34	45	56	66	77	88	99	110	121	132	143	155	166	177	188	200	211
		S2	6	11	19	34	48	62	76	90	103	116	130	143	156	169	182	195	208	221	234	247	260	273
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	3	3	3	3	4	4	4	4	4	4	4	5	5	5	5	5	5	5	6	6	6	6
		S1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1	1
		S2	7	7	7	7	7	8	8	8	8	8	9	9	9	9	10	10	10	10	10	11	11	11
	1 Day	BISPO	36	38	40	41	43	45	47	48	50	52	54	55	57	59	60	62	64	66	67	69	71	73
		S1	24	26	27	29	30	32	33	34	36	37	39	40	42	43	45	46	48	49	51	52	54	56
		S2	48	50	52	54	56	58	60	62	64	66	68	70	72	74	76	78	80	82	84	86	88	90
	7 Days	BISPO	254	266	278	290	302	314	327	339	351	363	375	387	399	411	423	435	448	460	472	484	496	508
		S1	222	233	245	256	268	279	290	302	313	325	336	348	359	371	382	394	405	417	428	440	451	463
		S2	286	299	312	324	337	350	363	375	388	401	414	426	439	452	465	477	490	503	515	528	540	553
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	6	6	6	7	7	7	7	7	7	7	8	8	8	8	8	8	8	9	9	9	9	
		S1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	
		S2	11	11	12	12	12	12	12	13	13	13	13	13	14	14	14	14	14	15	15	15	15	
	1 Day	BISPO	74	76	78	79	81	83	85	86	88	90	92	93	95	97	98	100	102	104	105	107	109	
		S1	57	59	60	62	63	65	66	68	69	71	72	74	76	77	79	80	82	83	85	86	88	
		S2	92	93	95	97	99	101	103	105	107	109	111	113	115	116	118	120	122	124	126	128	130	
	7 Days	BISPO	520	532	544	556	569	581	593	605	617	629	641	653	665	677	689	702	714	726	738	750	762	
		S1	475	486	498	509	521	532	544	556	567	579	590	602	614	625	637	649	660	672	684	695	707	
		S2	566	578	591	604	616	629	641	654	667	679	692	704	717	729	742	755	767	780	792	805	817	
X Invalid test: A longer test period is required.																								
* Test values do not provide 95% confidence for meeting the long-term performance. However, since a longer test is not practical, a limit of "0" is used for S1.																								

Table D.6/M.2101 – Allocated BBE performance objectives and limits for VC-1 and VC-2;
PO = 2.5×10^{-5} ; 2000 blocks/s; BISPO = $0.5 \times$ APO

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	2 hrs	BISPO	0	1	2	4	5	7	9	11	13	14	16	18	20	22	23	25	27	29	31	32	34	36	
		S1	X	X	X	0	1	2	3	4	6	7	8	10	11	12	14	15	17	18	20	21	23	24	
		S2	2	3	4	7	10	13	15	17	20	22	24	26	29	31	33	35	37	40	42	44	46	48	
	1 Day	BISPO	4	11	22	43	65	86	108	130	151	173	194	216	238	259	281	302	324	346	367	389	410	432	
		S1	0	4	12	30	49	68	87	107	127	147	167	187	207	227	247	268	288	308	329	349	370	390	
		S2	8	17	31	56	81	105	129	152	176	199	222	245	268	291	314	337	360	383	406	428	451	474	
	7 Days	BISPO	30	76	151	302	454	605	756	907	1058	1210	1361	1512	1663	1814	1966	2117	2268	2419	2570	2722	2873	3024	
		S1	19	58	127	268	411	556	701	847	993	1140	1287	1434	1582	1729	1877	2025	2173	2321	2469	2617	2766	2914	
		S2	41	93	176	337	496	654	811	967	1123	1279	1435	1590	1745	1900	2054	2209	2363	2518	2672	2826	2980	3134	
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	38	40	41	43	45	47	49	50	52	54	56	58	59	61	63	65	67	68	70	72	74	76	
		S1	26	27	29	30	32	33	35	36	38	39	41	42	44	46	47	49	50	52	53	55	57	58	
		S2	50	52	54	56	58	60	63	65	67	69	71	73	75	77	79	81	83	85	87	89	91	93	
	1 Day	BISPO	454	475	497	518	540	562	583	605	626	648	670	691	713	734	756	778	799	821	842	864	886	907	
		S1	411	432	452	473	494	514	535	556	576	597	618	639	659	680	701	722	743	764	784	805	826	847	
		S2	496	519	541	564	586	609	631	654	676	699	721	744	766	789	811	833	856	878	900	923	945	967	
	7 Days	BISPO	3175	3326	3478	3629	3780	3931	4082	4234	4385	4536	4687	4838	4990	5141	5292	5443	5594	5746	5897	6048	6199	6350	
		S1	3063	3211	3360	3508	3657	3806	3955	4103	4252	4401	4550	4699	4848	4997	5147	5296	5445	5594	5743	5892	6042	6191	
		S2	3288	3442	3596	3749	3903	4057	4210	4364	4517	4671	4824	4978	5131	5284	5437	5591	5744	5897	6050	6204	6357	6510	
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	77	79	81	83	85	86	88	90	92	94	95	97	99	101	103	104	106	108	110	112	113		
		S1	60	61	63	65	66	68	69	71	73	74	76	77	79	81	82	84	86	87	89	90	92		
		S2	95	97	99	101	103	105	107	109	111	113	115	117	119	121	123	125	127	129	131	133	135		
	1 Day	BISPO	929	950	972	994	1015	1037	1058	1080	1102	1123	1145	1166	1188	1210	1231	1253	1274	1296	1318	1339	1361		
		S1	868	889	910	931	951	972	993	1014	1035	1056	1077	1098	1119	1140	1161	1182	1203	1224	1245	1266	1287		
		S2	990	1012	1034	1057	1079	1101	1123	1146	1168	1190	1212	1235	1257	1279	1301	1324	1346	1368	1390	1412	1435		
	7 Days	BISPO	6502	6653	6804	6955	7106	7258	7409	7560	7711	7862	8014	8165	8316	8467	8618	8770	8921	9072	9223	9374	9526		
		S1	6340	6490	6639	6788	6938	7087	7237	7386	7536	7685	7835	7984	8134	8283	8433	8582	8732	8882	9031	9181	9330		
		S2	6663	6816	6969	7122	7275	7428	7581	7734	7887	8040	8193	8346	8498	8651	8804	8957	9110	9262	9415	9568	9721		
X Invalid test: A longer test period is required.																									
For shaded entries, the corresponding ES limit is 0 or invalid; for a BBE test to be successful, the corresponding ES measurement must not exceed 1.																									
NOTE – The values in this table are based on limited experience and are subject to change for future revisions.																									

Table D.7/M.2101 – Allocated BBE performance objectives and limits for VC-3; PO = 2.5×10^{-5} ; 8000 blocks/s; BISPO = $0.5 \times \text{APO}$

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	2 hrs	BISPO	1	4	7	14	22	29	36	43	50	58	65	72	79	86	94	101	108	115	122	130	137	144	
		S1	X	0	2	7	12	18	24	30	36	42	49	55	61	68	74	81	87	94	100	107	113	120	
		S2	4	7	13	22	31	40	48	56	65	73	81	89	97	105	113	121	129	137	145	152	160	168	
	1 Day	BISPO	17	43	86	173	259	346	432	518	605	691	778	864	950	1037	1123	1210	1296	1382	1469	1555	1642	1728	
		S1	9	30	68	147	227	308	390	473	556	639	722	805	889	972	1056	1140	1224	1308	1392	1476	1561	1645	
		S2	26	56	105	199	291	383	474	564	654	744	833	923	1012	1101	1190	1279	1368	1457	1545	1634	1723	1811	
	7 Days	BISPO	121	302	605	1210	1814	2419	3024	3629	4234	4838	5443	6048	6653	7258	7862	8467	9072	9677	10282	10886	11491	12096	
		S1	99	268	556	1140	1729	2321	2914	3508	4103	4699	5296	5892	6490	7087	7685	8283	8882	9480	10079	10678	11277	11876	
		S2	143	337	654	1279	1900	2518	3134	3749	4364	4978	5591	6204	6816	7428	8040	8651	9262	9874	10484	11095	11706	12316	
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	151	158	166	173	180	187	194	202	209	216	223	230	238	245	252	259	266	274	281	288	295	302	
		S1	127	133	140	147	153	160	167	173	180	187	193	200	207	214	220	227	234	241	247	254	261	268	
		S2	176	184	191	199	207	215	222	230	238	245	253	261	268	276	284	291	299	307	314	322	330	337	
	1 Day	BISPO	1814	1901	1987	2074	2160	2246	2333	2419	2506	2592	2678	2765	2851	2938	3024	3110	3197	3283	3370	3456	3542	3629	
		S1	1729	1814	1898	1983	2067	2152	2236	2321	2405	2490	2575	2660	2744	2829	2914	2999	3084	3169	3254	3338	3423	3508	
		S2	1900	1988	2076	2165	2253	2341	2429	2518	2606	2694	2782	2870	2958	3046	3134	3222	3310	3398	3486	3574	3661	3749	
	7 Days	BISPO	12701	13306	13910	14515	15120	15725	16330	16934	17539	18144	18749	19354	19958	20563	21168	21773	22378	22982	23587	24192	24797	25402	
		S1	12475	13075	13675	14274	14874	15474	16074	16674	17274	17875	18475	19075	19676	20276	20877	21478	22078	22679	23280	23881	24482	25083	
		S2	12926	13536	14146	14756	15366	15976	16585	17195	17804	18413	19023	19632	20241	20850	21459	22068	22677	23286	23894	24503	25112	25720	
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	310	317	324	331	338	346	353	360	367	374	382	389	396	403	410	418	425	432	439	446	454		
		S1	274	281	288	295	302	308	315	322	329	336	343	349	356	363	370	377	384	390	397	404	411		
		S2	345	352	360	368	375	383	390	398	406	413	421	428	436	443	451	458	466	474	481	489	496		
	1 Day	BISPO	3715	3802	3888	3974	4061	4147	4234	4320	4406	4493	4579	4666	4752	4838	4925	5011	5098	5184	5270	5357	5443		
		S1	3593	3678	3763	3848	3933	4018	4103	4189	4274	4359	4444	4529	4614	4699	4784	4870	4955	5040	5125	5210	5296		
		S2	3837	3925	4013	4100	4188	4276	4364	4451	4539	4627	4715	4802	4890	4978	5065	5153	5240	5328	5416	5503	5591		
	7 Days	BISPO	26006	26611	27216	27821	28426	29030	29635	30240	30845	31450	32054	32659	33264	33869	34474	35078	35683	36288	36893	37498	38102		
		S1	25684	26285	26886	27487	28088	28690	29291	29892	30494	31095	31696	32298	32899	33501	34102	34704	35305	35907	36509	37110	37712		
		S2	26329	26937	27546	28154	28763	29371	29979	30588	31196	31804	32412	33021	33629	34237	34845	35453	36061	36669	37277	37885	38493		
X Invalid test: A longer test period is required.																									
For shaded entries, the corresponding ES limit is 0 or invalid; for a BBE test to be successful, the corresponding ES measurement must not exceed 1.																									
NOTE – The values in this table are based on limited experience and are subject to change for future revisions.																									

**Table D.8/M.2101 – Allocated BBE performance objectives and limits for VC-4, VC-4-4c, VC-4-16c; PO = 5×10^{-5} ;
8000 blocks/s; BISPO = $0.5 \times \text{APO}$**

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	3	7	14	29	43	58	72	86	101	115	130	144	158	173	187	202	216	230	245	259	274	288
		S1	X	2	7	18	30	42	55	68	81	94	107	120	133	147	160	173	187	200	214	227	241	254
		S2	6	13	22	40	56	73	89	105	121	137	152	168	184	199	215	230	245	261	276	291	307	322
	1 Day	BISPO	35	86	173	346	518	691	864	1037	1210	1382	1555	1728	1901	2074	2246	2419	2592	2765	2938	3110	3283	3456
		S1	23	68	147	308	473	639	805	972	1140	1308	1476	1645	1814	1983	2152	2321	2490	2660	2829	2999	3169	3338
		S2	46	105	199	383	564	744	923	1101	1279	1457	1634	1811	1988	2165	2341	2518	2694	2870	3046	3222	3398	3574
	7 Days	BISPO	242	605	1210	2419	3629	4838	6048	7258	8467	9677	10886	12096	13306	14515	15725	16934	18144	19354	20563	21773	22982	24192
		S1	211	556	1140	2321	3508	4699	5892	7087	8283	9480	10678	11876	13075	14274	15474	16674	17875	19075	20276	21478	22679	23881
		S2	273	654	1279	2518	3749	4978	6204	7428	8651	9874	11095	12316	13536	14756	15976	17195	18413	19632	20850	22068	23286	24503
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	302	317	331	346	360	374	389	403	418	432	446	461	475	490	504	518	533	547	562	576	590	605
		S1	268	281	295	308	322	336	349	363	377	390	404	418	432	445	459	473	487	500	514	528	542	556
		S2	337	352	368	383	398	413	428	443	458	474	489	504	519	534	549	564	579	594	609	624	639	654
	1 Day	BISPO	3629	3802	3974	4147	4320	4493	4666	4838	5011	5184	5357	5530	5702	5875	6048	6221	6394	6566	6739	6912	7085	7258
		S1	3508	3678	3848	4018	4189	4359	4529	4699	4870	5040	5210	5381	5551	5722	5892	6063	6234	6404	6575	6746	6916	7087
		S2	3749	3925	4100	4276	4451	4627	4802	4978	5153	5328	5503	5678	5853	6028	6204	6379	6554	6728	6903	7078	7253	7428
	7 Days	BISPO	25402	26611	27821	29030	30240	31450	32659	33869	35078	36288	37498	38707	39917	41126	42336	43546	44755	45965	47174	48384	49594	50803
		S1	25083	26285	27487	28690	29892	31095	32298	33501	34704	35907	37110	38314	39517	40721	41924	43128	44332	45536	46740	47944	49148	50352
		S2	25720	26937	28154	29371	30588	31804	33021	34237	35453	36669	37885	39101	40316	41532	42748	43963	45178	46394	47609	48824	50039	51254
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	619	634	648	662	677	691	706	720	734	749	763	778	792	806	821	835	850	864	878	893	907	
		S1	569	583	597	611	625	639	652	666	680	694	708	722	736	750	764	777	791	805	819	833	847	
		S2	669	684	699	714	729	744	759	774	789	804	818	833	848	863	878	893	908	923	938	953	967	
	1 Day	BISPO	7430	7603	7776	7949	8122	8294	8467	8640	8813	8986	9158	9331	9504	9677	9850	10022	10195	10368	10541	10714	10886	
		S1	7258	7429	7600	7770	7941	8112	8283	8454	8625	8796	8967	9138	9309	9480	9651	9822	9993	10164	10335	10507	10678	
		S2	7603	7778	7952	8127	8302	8477	8651	8826	9001	9175	9350	9524	9699	9874	10048	10223	10397	10572	10746	10921	11095	
	7 Days	BISPO	52013	53222	54432	55642	56851	58061	59270	60480	61690	62899	64109	65318	66528	67738	68947	70157	71366	72576	73786	74995	76205	
		S1	51557	52761	53965	55170	56374	57579	58783	59988	61193	62398	63602	64807	66012	67217	68422	69627	70832	72037	73242	74447	75653	
		S2	52469	53684	54899	56113	57328	58543	59757	60972	62186	63401	64615	65830	67044	68258	69472	70687	71901	73115	74329	75543	76757	

X Invalid test: A longer test period is required.

For shaded entries, the corresponding ES limit is 0 or invalid; for a BBE test to be successful, the corresponding ES measurement must not exceed 1.

NOTE – The values in this table are based on limited experience and are subject to change for future revisions.

Table D.9/M.2101 – Allocated BBE performance objectives and limits for STM-0; $PO = 2.5 \times 10^{-5}$; 64 000 blocks/s; BISPO = $0.1 \times APO$

		Allocation	0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	2	6	12	23	35	46	58	69	81	92	104	115	127	138	150	161	173	184	196	207	219	230
		S1	X	1	5	13	23	33	42	52	63	73	83	94	104	115	125	136	147	157	168	179	189	200
		S2	5	11	18	33	46	60	73	86	99	111	124	137	149	162	174	187	199	211	224	236	248	261
	1 Day	BISPO	28	69	138	276	415	553	691	829	968	1106	1244	1382	1521	1659	1797	1935	2074	2212	2350	2488	2627	2765
		S1	17	52	115	243	374	506	639	772	905	1039	1174	1308	1443	1577	1712	1847	1983	2118	2253	2389	2524	2660
		S2	38	86	162	310	455	600	744	887	1030	1172	1315	1457	1599	1740	1882	2023	2165	2306	2447	2588	2729	2870
	7 Days	BISPO	194	484	968	1935	2903	3871	4838	5806	6774	7741	8709	9677	10644	11612	12580	13548	14515	15483	16451	17418	18386	19354
		S1	166	440	905	1847	2795	3746	4699	5654	6609	7565	8522	9480	10438	11397	12356	13315	14274	15234	16194	17154	18115	19075
		S2	221	528	1030	2023	3011	3995	4978	5958	6938	7917	8896	9874	10851	11828	12804	13780	14756	15732	16707	17682	18657	19632
Allocation		21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
Test Period	2 hrs	BISPO	242	253	265	276	288	300	311	323	334	346	357	369	380	392	403	415	426	438	449	461	472	484
		S1	211	222	232	243	254	265	276	287	298	308	319	330	341	352	363	374	385	396	407	418	429	440
		S2	273	285	298	310	322	334	346	358	371	383	395	407	419	431	443	455	468	480	492	504	516	528
	1 Day	BISPO	2903	3041	3180	3318	3456	3594	3732	3871	4009	4147	4285	4424	4562	4700	4838	4977	5115	5253	5391	5530	5668	5806
		S1	2795	2931	3067	3203	3338	3474	3610	3746	3882	4018	4155	4291	4427	4563	4699	4836	4972	5108	5245	5381	5517	5654
		S2	3011	3152	3292	3433	3574	3714	3855	3995	4136	4276	4416	4557	4697	4837	4978	5118	5258	5398	5538	5678	5818	5958
	7 Days	BISPO	20321	21289	22257	23224	24192	25160	26127	27095	28063	29030	29998	30966	31933	32901	33869	34836	35804	36772	37740	38707	39675	40643
		S1	20036	20997	21958	22920	23881	24842	25804	26766	27728	28690	29652	30614	31576	32538	33501	34463	35426	36388	37351	38314	39277	40239
		S2	20606	21581	22555	23529	24503	25477	26451	27424	28398	29371	30344	31318	32291	33264	34237	35210	36183	37155	38128	39101	40073	41046
Allocation		43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
Test Period	2 hrs	BISPO	495	507	518	530	541	553	564	576	588	599	611	622	634	645	657	668	680	691	703	714	726	
		S1	451	462	473	484	495	506	517	528	539	550	561	572	583	594	605	616	628	639	650	661	672	
		S2	540	552	564	576	588	600	612	624	636	648	660	672	684	696	708	720	732	744	756	768	780	
	1 Day	BISPO	5944	6083	6221	6359	6497	6636	6774	6912	7050	7188	7327	7465	7603	7741	7880	8018	8156	8294	8433	8571	8709	
		S1	5790	5927	6063	6200	6336	6473	6609	6746	6882	7019	7156	7292	7429	7565	7702	7839	7976	8112	8249	8386	8522	
		S2	6099	6239	6379	6519	6658	6798	6938	7078	7218	7358	7498	7638	7778	7917	8057	8197	8337	8477	8616	8756	8896	
	7 Days	BISPO	41610	42578	43546	44513	45481	46449	47416	48384	49352	50319	51287	52255	53222	54190	55158	56125	57093	58061	59028	59996	60964	
		S1	41202	42165	43128	44091	45054	46018	46981	47944	48907	49871	50834	51798	52761	53725	54688	55652	56615	57579	58543	59506	60470	
		S2	42018	42991	43963	44935	45907	46880	47852	48824	49796	50768	51740	52712	53684	54656	55627	56599	57571	58543	59514	60486	61458	
For shaded entries, the corresponding ES limit is 0 or invalid; for a BBE test to be successful, the corresponding ES measurement must not exceed 1.																								
NOTE – The values in this table are based on limited experience and are subject to change for future revisions.																								

Table D.10/M.2101 – Allocated BBE performance objectives and limits for STM-1 (1/10 of Blocks);
PO = 5×10^{-5} ; 192 000 blocks/s; BISPO = $0.1 \times \text{APO}$

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	1,4	3,5	6,9	13,8	20,7	27,6	34,6	41,5	48,4	55,3	62,2	69,1	76,0	82,9	89,9	96,8	103,7	110,6	117,5	124,4	131,3	138,2
		S1	0,6	2,3	5,2	11,5	17,9	24,3	30,8	37,4	44,0	50,6	57,2	63,9	70,5	77,2	83,9	90,5	97,2	103,9	110,6	117,4	124,1	130,8
		S2	2,1	4,6	8,6	16,2	23,6	31,0	38,3	45,5	52,8	60,0	67,2	74,4	81,5	88,7	95,9	103,0	110,1	117,2	124,4	131,5	138,6	145,7
	1 Day	BISPO	16,6	41,5	82,9	165,9	248,8	331,8	414,7	497,7	580,6	663,6	746,5	829,4	912,4	995,3	1078	1161	1244	1327	1410	1493	1576	1659
		S1	14,0	37,4	77,2	157,7	238,9	320,3	401,8	483,6	565,4	647,3	729,2	811,2	893,3	975,4	1058	1140	1222	1304	1386	1469	1551	1633
		S2	19,2	45,5	88,7	174,0	258,8	343,3	427,6	511,8	595,8	679,8	763,8	847,7	931,5	1015	1099	1183	1266	1350	1434	1517	1601	1685
	7 Days	BISPO	116,1	290,3	580,6	1161	1742	2322	2903	3484	4064	4645	5225	5806	6387	6967	7548	8129	8709	9290	9870	10451	11032	11612
		S1	109,3	279,5	565,4	1140	1715	2292	2869	3446	4024	4602	5180	5758	6336	6915	7493	8071	8650	9229	9808	10386	10965	11544
		S2	122,9	301,1	595,8	1183	1768	2353	2937	3521	4105	4688	5271	5854	6437	7020	7603	8186	8768	9351	9933	10516	11098	11680
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	145,2	152,1	159,0	165,9	172,8	179,7	186,6	193,5	200,4	207,4	214,3	221,2	228,1	235,0	241,9	248,8	255,7	262,7	269,6	276,5	283,4	290,3
		S1	137,5	144,3	151,0	157,7	164,5	171,2	178,0	184,7	191,5	198,3	205,0	211,8	218,5	225,3	232,1	238,9	245,6	252,4	259,2	266,0	272,7	279,5
		S2	152,8	159,9	167,0	174,0	181,1	188,2	195,3	202,3	209,4	216,5	223,5	230,6	237,6	244,7	251,8	258,8	265,9	272,9	280,0	287,0	294,0	301,1
	1 Day	BISPO	1742	1825	1908	1991	2074	2157	2239	2322	2405	2488	2571	2654	2737	2820	2903	2986	3069	3152	3235	3318	3401	3484
		S1	1715	1798	1880	1962	2045	2127	2210	2292	2374	2457	2539	2622	2704	2787	2869	2951	3034	3116	3199	3281	3364	3446
		S2	1768	1852	1935	2019	2102	2186	2269	2353	2436	2520	2603	2687	2770	2854	2937	3021	3104	3187	3271	3354	3438	3521
	7 Days	BISPO	12193	12773	13354	13935	14515	15096	15676	16257	16838	17418	17999	18579	19160	19741	20321	20902	21482	22063	22644	23224	23805	24386
		S1	12123	12702	13281	13860	14439	15018	15597	16176	16756	17335	17914	18493	19073	19652	20231	20810	21390	21969	22549	23128	23707	24287
		S2	12263	12845	13427	14009	14591	15174	15756	16338	16920	17502	18084	18666	19248	19830	20411	20993	21575	22157	22739	23321	23903	24484
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	297,2	304,1	311,0	318,0	324,9	331,8	338,7	345,6	352,5	359,4	366,3	373,2	380,2	387,1	394,0	400,9	407,8	414,7	421,6	428,5	435,5	
		S1	286,3	293,1	299,9	306,7	313,5	320,3	327,0	333,8	340,6	347,4	354,2	361,0	367,8	374,6	381,4	388,2	395,0	401,8	408,6	415,5	422,3	
		S2	308,1	315,2	322,2	329,2	336,3	343,3	350,3	357,4	364,4	371,4	378,4	385,5	392,5	399,5	406,5	413,6	420,6	427,6	434,6	441,6	448,7	
	1 Day	BISPO	3567	3650	3732	3815	3898	3981	4064	4147	4230	4313	4396	4479	4562	4645	4728	4811	4894	4977	5060	5143	5225	
		S1	3529	3611	3694	3776	3859	3941	4024	4106	4189	4272	4354	4437	4519	4602	4684	4767	4849	4932	5015	5097	5180	
		S2	3604	3688	3771	3854	3938	4021	4105	4188	4271	4355	4438	4521	4605	4688	4771	4855	4938	5021	5105	5188	5271	
	7 Days	BISPO	24966	25547	26127	26708	27289	27869	28450	29030	29611	30192	30772	31353	31933	32514	33095	33675	34256	34836	35417	35998	36578	
		S1	24866	25446	26025	26605	27184	27764	28343	28923	29502	30082	30661	31241	31820	32400	32980	33559	34139	34718	35298	35878	36457	
		S2	25066	25648	26230	26811	27393	27975	28556	29138	29720	30302	30883	31465	32046	32628	33210	33791	34373	34955	35536	36118	36699	

For shaded entries, the corresponding ES limit is 0 or invalid; for a BBE test to be successful, the corresponding ES measurement must not exceed 1.

NOTE – The values in this table shall be multiplied by 10. They are based on limited experience and are subject to change for future revisions.

Table D.11/M.2101 – Allocated BBE performance objectives and limits for STM-4 (1/100 of Blocks);
PO = 5×10^{-5} ; 768 000 blocks/s; BISPO = $0.1 \times \text{APO}$

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	0,55	1,38	2,76	5,53	8,29	11,06	13,82	16,59	19,35	22,12	24,88	27,65	30,41	33,18	35,94	38,71	41,47	44,24	47,00	49,77	52,53	55,30
		S1	0,40	1,15	2,43	5,06	7,72	10,39	13,08	15,77	18,47	21,18	23,89	26,60	29,31	32,03	34,74	37,46	40,18	42,91	45,63	48,36	51,08	53,81
		S2	0,70	1,62	3,10	6,00	8,87	11,72	14,57	17,40	20,23	23,06	25,88	28,70	31,52	34,33	37,14	39,95	42,76	45,57	48,37	51,18	53,98	56,78
	1 Day	BISPO	6,64	16,59	33,18	66,36	99,53	132,7	165,9	199,1	232,2	265,4	298,6	331,8	365,0	398,1	431,3	464,5	497,7	530,8	564,0	597,2	630,4	663,6
		S1	6,12	15,77	32,03	64,73	97,54	130,4	163,3	196,2	229,2	262,2	295,1	328,1	361,1	394,1	427,2	460,2	493,2	526,2	559,3	592,3	625,4	658,4
		S2	7,15	17,40	34,33	67,98	101,5	135,0	168,5	201,9	235,3	268,7	302,1	335,4	368,8	402,1	435,5	468,8	502,1	535,4	568,8	602,1	635,4	668,7
	7 Days	BISPO	46,45	116,1	232,2	464,5	696,7	929,0	1161	1393	1626	1858	2090	2322	2555	2787	3019	3251	3484	3716	3948	4180	4413	4645
		S1	45,09	114,0	229,2	460,2	691,5	922,9	1154	1386	1618	1849	2081	2313	2545	2776	3008	3240	3472	3704	3936	4167	4399	4631
		S2	47,81	118,3	235,3	468,8	702,0	935,1	1168	1401	1634	1867	2099	2332	2565	2797	3030	3263	3495	3728	3961	4193	4426	4658
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	58,06	60,83	63,59	66,36	69,12	71,88	74,65	77,41	80,18	82,94	85,71	88,47	91,24	94,00	96,77	99,53	102,3	105,1	107,8	110,6	113,4	116,1
		S1	56,54	59,27	62,00	64,73	67,46	70,19	72,92	75,65	78,39	81,12	83,86	86,59	89,33	92,06	94,80	97,54	100,3	103,0	105,8	108,5	111,2	114,0
		S2	59,58	62,39	65,19	67,98	70,78	73,58	76,38	79,17	81,97	84,77	87,56	90,35	93,15	95,94	98,74	101,5	104,3	107,1	109,9	112,7	115,5	118,3
	1 Day	BISPO	696,7	729,9	763,1	796,3	829,4	862,6	895,8	929,0	962,2	995,3	1029	1062	1095	1128	1161	1194	1228	1261	1294	1327	1360	1393
		S1	691,5	724,5	757,6	790,6	823,7	856,7	889,8	922,9	955,9	989,0	1022	1055	1088	1121	1154	1187	1221	1254	1287	1320	1353	1386
		S2	702,0	735,3	768,6	801,9	835,2	868,5	901,8	935,1	968,4	1002	1035	1068	1101	1135	1168	1201	1235	1268	1301	1334	1368	1401
	7 Days	BISPO	4877	5109	5342	5574	5806	6038	6271	6503	6735	6967	7200	7432	7664	7896	8129	8361	8593	8825	9057	9290	9522	9754
		S1	4863	5095	5327	5559	5791	6023	6255	6487	6719	6951	7183	7415	7647	7878	8110	8342	8574	8806	9038	9270	9502	9734
		S2	4891	5124	5356	5589	5821	6054	6286	6519	6751	6984	7217	7449	7682	7914	8147	8379	8612	8844	9077	9309	9541	9774
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	118,9	121,7	124,4	127,2	129,9	132,7	135,5	138,2	141,0	143,8	146,5	149,3	152,1	154,8	157,6	160,4	163,1	165,9	168,7	171,4	174,2	
		S1	116,7	119,4	122,2	124,9	127,7	130,4	133,1	135,9	138,6	141,4	144,1	146,9	149,6	152,3	155,1	157,8	160,6	163,3	166,1	168,8	171,5	
		S2	121,1	123,9	126,6	129,4	132,2	135,0	137,8	140,6	143,4	146,2	149,0	151,7	154,5	157,3	160,1	162,9	165,7	168,5	171,3	174,0	176,8	
	1 Day	BISPO	1427	1460	1493	1526	1559	1593	1626	1659	1692	1725	1758	1792	1825	1858	1891	1924	1957	1991	2024	2057	2090	
		S1	1419	1452	1485	1518	1551	1585	1618	1651	1684	1717	1750	1783	1816	1849	1882	1916	1949	1982	2015	2048	2081	
		S2	1434	1467	1501	1534	1567	1601	1634	1667	1700	1734	1767	1800	1833	1867	1900	1933	1966	2000	2033	2066	2099	
	7 Days	BISPO	9986	10219	10451	10683	10915	11148	11380	11612	11844	12077	12309	12541	12773	13006	13238	13470	13702	13935	14167	14399	14631	
		S1	9966	10198	10430	10663	10895	11127	11359	11591	11823	12055	12287	12519	12751	12983	13215	13447	13679	13911	14143	14375	14607	
		S2	10006	10239	10471	10704	10936	11169	11401	11634	11866	12099	12331	12564	12796	13028	13261	13493	13726	13958	14191	14423	14656	

NOTE – The values in this table shall be multiplied by 100. They are based on limited experience and are subject to change for future revisions.

Table D.12/M.2101 – Allocated BBE performance objectives and limits for STM-16 (1/100 of Blocks);

PO = 5×10^{-5} ; 3 072 000 blocks/s; BISPO = $0.1 \times \text{APO}$

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	2,21	5,53	11,06	22,12	33,18	44,24	55,30	66,36	77,41	88,47	99,53	110,6	121,7	132,7	143,8	154,8	165,9	176,9	188,0	199,1	210,1	221,2
		S1	1,91	5,06	10,39	21,18	32,03	42,91	53,81	64,73	75,65	86,59	97,54	108,5	119,4	130,4	141,4	152,3	163,3	174,3	185,3	196,2	207,2	218,2
		S2	2,51	6,00	11,72	23,06	34,33	45,57	56,78	67,98	79,17	90,35	101,5	112,7	123,9	135,0	146,2	157,3	168,5	179,6	190,7	201,9	213,0	224,2
	1 Day	BISPO	26,54	66,36	132,7	265,4	398,1	530,8	663,6	796,3	929,0	1062	1194	1327	1460	1593	1725	1858	1991	2123	2256	2389	2521	2654
		S1	25,51	64,73	130,4	262,2	394,1	526,2	658,4	790,6	922,9	1055	1187	1320	1452	1585	1717	1849	1982	2114	2247	2379	2511	2644
		S2	27,57	67,98	135,0	268,7	402,1	535,4	668,7	801,9	935,1	1068	1201	1334	1467	1601	1734	1867	2000	2133	2266	2399	2532	2665
	7 Days	BISPO	185,8	464,5	929,0	1858	2787	3716	4645	5574	6503	7432	8361	9290	10219	11148	12077	13006	13935	14864	15793	16722	17650	18579
		S1	183,1	460,2	922,9	1849	2776	3704	4631	5559	6487	7415	8342	9270	10198	11127	12055	12983	13911	14839	15767	16696	17624	18552
		S2	188,5	468,8	935,1	1867	2797	3728	4658	5589	6519	7449	8379	9309	10239	11169	12099	13028	13958	14888	15818	16747	17677	18607
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	232,2	243,3	254,4	265,4	276,5	287,5	298,6	309,7	320,7	331,8	342,8	353,9	365,0	376,0	387,1	398,1	409,2	420,2	431,3	442,4	453,4	464,5
		S1	229,2	240,2	251,2	262,2	273,2	284,1	295,1	306,1	317,1	328,1	339,1	350,1	361,1	372,1	383,1	394,1	405,1	416,1	427,2	438,2	449,2	460,2
		S2	235,3	246,4	257,6	268,7	279,8	290,9	302,1	313,2	324,3	335,4	346,5	357,7	368,8	379,9	391,0	402,1	413,2	424,3	435,5	446,6	457,7	468,8
	1 Day	BISPO	2787	2920	3052	3185	3318	3450	3583	3716	3849	3981	4114	4247	4379	4512	4645	4778	4910	5043	5176	5308	5441	5574
		S1	2776	2909	3041	3174	3306	3439	3571	3704	3836	3969	4101	4234	4366	4499	4631	4764	4896	5029	5161	5294	5426	5559
		S2	2797	2930	3063	3196	3329	3462	3595	3728	3861	3994	4127	4260	4393	4526	4658	4791	4924	5057	5190	5323	5456	5589
	7 Days	BISPO	19508	20437	21366	22295	23224	24153	25082	26011	26940	27869	28798	29727	30656	31585	32514	33443	34372	35301	36230	37159	38088	39017
		S1	19480	20409	21337	22265	23194	24122	25051	25979	26907	27836	28764	29693	30621	31550	32478	33406	34335	35263	36192	37120	38049	38977
		S2	19536	20466	21396	22325	23255	24184	25114	26043	26973	27903	28832	29762	30691	31621	32550	33480	34409	35339	36268	37197	38127	39056
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	475,5	486,6	497,7	508,7	519,8	530,8	541,9	553,0	564,0	575,1	586,1	597,2	608,3	619,3	630,4	641,4	652,5	663,6	674,6	685,7	696,7	
		S1	471,2	482,2	493,2	504,2	515,2	526,2	537,2	548,3	559,3	570,3	581,3	592,3	603,3	614,3	625,4	636,4	647,4	658,4	669,4	680,4	691,5	
		S2	479,9	491,0	502,1	513,2	524,3	535,4	546,6	557,7	568,8	579,9	591,0	602,1	613,2	624,3	635,4	646,5	657,6	668,7	679,8	690,9	702,0	
	1 Day	BISPO	5707	5839	5972	6105	6237	6370	6503	6636	6768	6901	7034	7166	7299	7432	7564	7697	7830	7963	8095	8228	8361	
		S1	5691	5824	5957	6089	6222	6354	6487	6619	6752	6884	7017	7149	7282	7415	7547	7680	7812	7945	8077	8210	8342	
		S2	5722	5855	5987	6120	6253	6386	6519	6652	6785	6918	7050	7183	7316	7449	7582	7715	7848	7980	8113	8246	8379	
	7 Days	BISPO	39946	40875	41804	42733	43662	44591	45520	46449	47378	48307	49236	50165	51094	52022	52951	53880	54809	55738	56667	57596	58525	
		S1	39906	40834	41763	42691	43620	44548	45477	46406	47334	48263	49191	50120	51048	51977	52905	53834	54763	55691	56620	57548	58477	
		S2	39986	40915	41845	42774	43704	44633	45562	46492	47421	48351	49280	50209	51139	52068	52997	53927	54856	55786	56715	57644	58574	
NOTE 1 – The values in this table shall be multiplied by 100. They are based on limited experience and are subject to change for future revisions.																								
NOTE 2 – STM-64 is for further study.																								

**Table D.13/M.2101 – Allocated SES performance objectives and limits for all VC and STM rates;
PO = 0.1%; BISPO = 0.5 × APO**

Allocation			0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0
Test Period	2 hrs	BISPO	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	1	1	1	1	1
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		S2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	1 Day	BISPO	0	0	0	1	1	2	2	3	3	3	4	4	5	5	6	6	6	7	7	8	8	9
		S1	X	X	X	X	X	X	X	X	0	0	0	0	0	1	1	1	1	2	2	2	2	3
		S2	1	1	2	3	4	4	5	6	7	7	8	8	9	10	10	11	12	12	13	13	14	15
	7 Days	BISPO	1	2	3	6	9	12	15	18	21	24	27	30	33	36	39	42	45	48	51	54	57	60
		S1	0*	0*	0	1	3	5	7	10	12	14	17	19	22	24	27	29	32	34	37	40	42	45
		S2	2	4	7	11	15	19	23	27	30	34	38	41	45	48	52	55	59	62	66	69	73	76
Allocation			21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0
Test Period	2 hrs	BISPO	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
		S2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
	1 Day	BISPO	9	10	10	10	11	11	12	12	13	13	13	14	14	15	15	16	16	16	17	17	18	18
		S1	3	3	4	4	4	5	5	5	5	6	6	6	7	7	7	8	8	8	9	9	9	10
		S2	15	16	16	17	17	18	18	19	20	20	21	21	22	22	23	23	24	25	25	26	26	27
	7 Days	BISPO	64	67	70	73	76	79	82	85	88	91	94	97	100	103	106	109	112	115	118	121	124	127
		S1	48	50	53	56	58	61	64	66	69	72	74	77	80	83	85	88	91	93	96	99	102	104
		S2	79	83	86	90	93	96	100	103	106	110	113	116	120	123	126	130	133	136	140	143	146	150
Allocation			43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0	
Test Period	2 hrs	BISPO	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	
		S1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
		S2	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	
	1 Day	BISPO	19	19	19	20	20	21	21	22	22	22	23	23	24	24	25	25	25	26	26	27	27	
		S1	10	10	11	11	11	12	12	12	13	13	13	14	14	14	15	15	15	16	16	16	17	
		S2	27	28	28	29	29	30	30	31	31	32	32	33	34	34	35	35	36	36	37	37	38	
	7 Days	BISPO	130	133	136	139	142	145	148	151	154	157	160	163	166	169	172	175	178	181	184	187	191	
		S1	107	110	113	116	118	121	124	127	129	132	135	138	141	143	146	149	152	155	157	160	163	
		S2	153	156	159	163	166	169	173	176	179	182	186	189	192	195	199	202	205	208	212	215	218	

X Invalid test: A longer test period is required.

* Test values do not provide 95% confidence for meeting long-term performance. However, since a longer test is not practical, a limit of "0" is used for S1.

**Table D.14/M.2101 – Allocated SEP performance objectives and limits for all VC and STM rates;
 $PO = 1 \times 10^{-4}$; $BISPO = 0.5 \times APO$; Seven day test only**

		Allocation	0.2	0.5	1.0	2.0	3.0	4.0	5.0	6.0	7.0	8.0	9.0	10.0	11.0	12.0	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	
Test Period	7 Days	BISPO	0	0	0	1	1	1	2	2	2	2	3	3	3	4	4	4	5	5	5	5	6	6	
		S1	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0*	0	0	0	0	0	0	0	0	1	1	1	1
		S2	1	1	1	2	3	3	4	5	5	6	6	7	7	7	8	8	9	9	10	10	11	11	11
	Allocation		21.0	22.0	23.0	24.0	25.0	26.0	27.0	28.0	29.0	30.0	31.0	32.0	33.0	34.0	35.0	36.0	37.0	38.0	39.0	40.0	41.0	42.0	
	7 Days	BISPO	6	7	7	7	8	8	8	8	9	9	9	10	10	10	11	11	11	11	12	12	12	13	
		S1	1	1	2	2	2	2	2	3	3	3	3	3	4	4	4	4	4	4	5	5	5	5	6
		S2	11	12	12	13	13	13	14	14	15	15	15	16	16	17	17	17	17	18	18	19	19	19	20
	Allocation		43.0	44.0	45.0	46.0	47.0	48.0	49.0	50.0	51.0	52.0	53.0	54.0	55.0	56.0	57.0	58.0	59.0	60.0	61.0	62.0	63.0		
	7 Days	BISPO	13	13	14	14	14	15	15	15	15	16	16	16	17	17	17	18	18	18	18	19	19		
		S1	6	6	6	6	7	7	7	7	8	8	8	8	8	9	9	9	9	9	10	10	10	10	
		S2	20	21	21	21	22	22	22	23	23	23	24	24	24	25	25	26	26	26	27	27	27	28	
	* Test values do not provide 95% confidence for meeting long-term performance. However, since a longer test is not practical, a limit of "0" is used for S1.																								
NOTE – The use of SEP and the limits for maintenance are under study.																									

ANNEX E

Default unacceptable performance level threshold values

Table E.1/M.2101 – Default unacceptable performance level threshold values for international synchronous digital paths and multiplex sections at a fixed 15-minute period

Digital paths – Set thresholds									
Allocation %	VC-1, VC-2			VC-3			VC-4		
	ES*	BBE	SES*	ES*	BBE	SES*	ES*	BBE	SES*
0.2-34	80	200	10	100	700	10	120	700	10
35-63	120	300	15	150	1 100	15	180	1 100	15
Digital paths – Reset thresholds									
Allocation %	VC-1, VC-2			VC-3			VC-4		
	ES	BBE	SES	ES	BBE	SES	ES	BBE	SES
0.2-34	1	6	0	1	25	0	1	25	0
35-63	2	12	0	3	50	0	4	50	0
Multiplex Sections – Set thresholds									
Allocation %	STM-0			STM-1			STM-4		
	ES	BBE	SES*	ES	BBE	SES*	ES	BBE	SES*
0.2-34	34	5 000	6	67	16 000	6	N/A	128 000	6
35-63	57	9 000	10	114	27 000	10	N/A	220 000	10
Multiplex Sections – Reset thresholds									
Allocation %	STM-0			STM-1			STM-4		
	ES	BBE	SES	ES	BBE	SES	ES	BBE	SES
0.2-34	1	200	0	2	600	0	N/A	5 000	0
35-63	2	400	0	4	1 100	0	N/A	9 000	0
* Since a 15-minute period is not significant for ES and SES, these are practical values.									
NOTE – Rates above VC-4 and STM-4 are for further study.									

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