Aerodrome Obstacle Surfaces – The new concept

First Version 1.1~~0~~

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OLS Task Force

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1 Introduction

The 12th Air Navigation Conference and the 38th ICAO Assembly called for a significant review of the Annex 14 Obstacle Limitation Surface (OLS) and for guidelines to be developed for conducting aeronautical studies to assess permissible penetrations. This direction resulted in the establishment of job card ADOP003 titled “Obstacle Limitation Surfaces at Aerodromes.”

The document presents the vision for the future management of obstacles within the aerodrome boundary and in the vicinity of an aerodrome given that aircraft and systems performances have evolved and significantly reduced aircraft deviations and considering the need to create a better economical balance between ground space and airspace.

Annex 14 OLS have origins in the 1950`s and they mostly reflect operational considerations at that time. Historically the broad purpose of Annex 14 OLS has been to define the volume of airspace that should ideally be kept free from obstacles in order to minimize the dangers presented by obstacles to an aircraft. The OLS have been always intended to be of a permanent nature and often enacted in the local zoning laws and ordinances or as part of the national planning consultation scheme.

However, the OLS as currently defined do not adequately protect airspace for the intended instrument flight operations consistent with the Global Air Navigation Plan. The OLS no longer reflect the performance characteristics of modern aircraft and air navigation systems. The OLS extend too far without providing an adequate obstacle protection for the intended instrument procedures. The dimensions of the current Annex 14 surfaces depend on the reference code of the runway (which is based from a design perspective on the obsolete concept of the reference field length and the identified critical aeroplane for which the aerodrome is intended) and the type of approach. Based on that code, the dimensions are established independently of the operational use of the runway.

Taking into account all these considerations this paper provides the rationale for changing the existing requirements and the criteria through which the revision will be achieved. The new concept will identify surfaces which will more effectively protect the aerodrome from an excessive growth of obstacles while providing flexibility for States to manage the obstacle environment and the requirements with their airspace.

2 Purpose of the document

This document lays out the conceptual foundation for the comprehensive review of ICAO Annex 14- Chapter 4, PANS-Aerodromes, PANS-OPS and Doc.9137, Airport Service Manual – Part VI. This will form part of the complete review of Annex 14 as directed by the ANC.

The document describes the deficiencies of the existing system and the impact of these deficiencies on current operations and regulations. Once the problems have been clearly recognized, the objectives and basic principles to solve the indicated issues are presented. The characteristics and capabilities of the proposed system are defined and details are provided on the benefits associated with its implementation. A future document will provide an impact assessment and proposed implementation plan.

3 Problem Statements

3.1 Purpose of existing Annex 14 OLS

The Annex 14 OLS purpose is to protect a volume of airspace to preserve the safety, accessibility (regularity) and efficiency of the aerodrome.

Comment [K1]: Safety added

Comment [WY2]: This statement seems contradicting the above (and Not under Chapter 4 of the Annex) in that th above text indicates that safety is one o the purposes of Annex 14 OLS.

The ICAO Annex 14 OLS have origins in the 1950s and were established to define the volume of airspace to be kept free from obstacles in order to minimize the dangers presented by obstacles to an aircraft, either during an entirely visual approach or during the visual segment of an instrument approach.

The objective of the approach and take-off surfaces was to limit obstacles in the vicinity of the aerodrome (in the runway axis and sometimes in the curves for curved sections of approach and departure procedures). However in 1958 (3rd edition of Annex 14), surfaces associated with take-off and landing were separated because of their different objectives and thus different specifications.

The mix between accessibility and safety objectives has resulted in confused arguments when States assess the acceptability of a penetration of the OLS. When safety alone is invoked in place of efficiency or economic consideration without rational consideration, it reduces the credibility of obstacle limitation requirements.

3.2 The evolution of the existing surfaces

Comment [WY3]: The information provided below seems not adequate to justify this statement.

Comment [K4]: Title changed to clar

The analysis of historical documentation related to the evolution and development of the OLS (e.g. amendments to Annex 14, Obstacle Clearance Panel (OCP) Reports, Aerodrome Reference Code Panel (ARCP) reports) has confirmed the purpose of each of those surfaces.

Historical ICAO documents show the objective of the transitional surface is to protect aircraft from cross-wind and to allow a proper connection between inner horizontal surface and approach surface.

The Obstacle Free Zone (OFZ) was introduced for safety reasons in the early 1970`s as obstacles penetrated the transitional surface. This was not satisfactory in the case of precision approaches. The creation of the inner transitional surface of the OFZ assumed that obstacles could exist between it and the transitional surface because the OLS are limitation surfaces and are not required to be totally free from obstacle penetration.

Additional complexity was created by the introduction of the inner approach surface intended to protect the line of sight of the approach lighting system, while the protection from obstacles remained the role of the approach surface.

3.3 Inconsistency between the current OLS, modern aircraft performance and the Global Air Navigation Plan (GANP)

An analysis was carried out to identify technical justification for the dimensions of the surfaces. The conclusion was that the historic OLS dimensions were initially deemed satisfactory but have remained unchanged with the evolution of aircraft performance and navigation. It was difficult to find rationale for some specifications of the OLS. Furthermore, a number of surfaces are now not achieving their original objective. For instance the relationship between the crosswind limitation, the width of the approach surface and the slope of the transitional surface cannot be found.

The dimensions of Annex 14 surfaces depend on the runway classification and aerodrome reference code number. The aerodrome reference code number is based on the aeroplane reference field length which in turn is based on a concept that is now not relevant to the performance of modern aircraft.

For example, the inner horizontal and conical surfaces share the same historical objective to protect aircraft flying aerodrome circuit patterns and visual circling. The present dimensions are too small and do not allow many high performance aeroplanes to perform these manoeuvres with protection from obstacles.

Comment [WY5]: Not clear. Does th mean the existing dimensions are too s

3.4 Inconsistencies between Annex 14, Annex 6 and PANS OPS requirements

Chapter 4 of Annex 14 clearly states that *the purpose of OLS are to define the airspace around aerodromes to be maintained free from obstacles so as to permit the intended aeroplane operations at the aerodromes to be conducted safely and to prevent the* *aerodromes from becoming unusable by the growth of obstacles around the aerodromes. This is achieved by establishing a series of obstacle limitation surfaces that define the limits to which objects may project into the airspace.*

PANS OPS Volume II states that*Construction of Visual and Instrument Flight Procedures is intended for the guidance of procedures specialists and describes the essential areas and obstacle clearance requirements for the achievement of safe, regular instrument flight operations*.

The PANS OPS purpose is to determine the lowest possible operating minima for the instrument flight procedure (safety objective).

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Based on the historical elements of OLS objectives, particularly the fact that they aimed at protecting aircraft operations, the link between the OLS and the PANS OPS surfaces seemed to be obvious. However, OLS and PANS OPS surfaces do not correspond at all, mostly because their dimensions depend on different criteria.

Annex 14 OLS have not undergone substantial changes through the years. PANS OPS surfaces have and will continue to evolve. This has created an inconsistency between the two sets of criteria with the OLS still reflecting operations applicable in the 1950's. The OLS as currently specified in Table 4-1 and Table 4-2 of Annex 14 Vol. I do not properly encompass instrument procedures. Furthermore, the requirements contained in Annex 14 with respect to the OLS do not contain any reference to the PANS OPS surfaces and likewise there is no referem=nce in PANS OPS to Annex 14 OLS.

Neither set of standards currently address the issue of the protection of emergency procedures (designed by aircraft operators) such as one engine inoperative take-off..

3.5 Current OLS require updating to protect new procedures and flight operations.

Current OLS provide protection for straight-in types of operations which today represent the majority of the operations at most aerodromes. Annex 14 specifications were established in consideration of previous navaids up to MLS and need be updated in consideration of modern navigation technologies. However, they do not adequately address other derivative operations such as approaches with curved paths, CDAs or RNAV/RNP to (and from) xLS transitions which will significantly increase in the near future.

Comment [WY6]: See Annex 14, 4.1 and 4.1.10 where curved operations are mentioned, as a result of the 12th meet of OCP in 1999.

Comment [AE7]: The annex does no provide sufficient guidance for PBN base procedures.

The majority of the aerodromes, on a global basis, are striving for increased safety and capacity. New technologies, including Performance Based Navigation (PBN) approaches, represent one of the available means to achieve this objective. Sufficient flexibility would allow for the increase of PBN procedures. For example, the replacement of CATI ILS by APV and RNP AR approaches.

3.6 Lack of standards and guidelines for conducting aeronautical studies

The airspace around aerodromes is a precious commodity and there is ever increasing pressure from property developers seeking to construct high-rise buildings and other structures in the vicinity of the aerodromes. These developers are able to commission detailed aeronautical studies themselves and challenge the existing limitations for airspace protection, including the applicability of Annex 14 OLS, in particular when there is no obvious link between the limitation surfaces and the way the actual aircraft operations are conducted at an aerodrome.

In this environment, it is increasingly difficult and costly for aerodrome operators to justify airspace protection limits. As a consequence, aerodrome operators and States might not have the authority to control the obstacle development in the surrounding of the aerodrome.

Existing recommendations in ICAO Annex 14 specify that OLS penetrations might be allowed when the result of aeronautical study indicates that the obstacle does not create a hazard to the safe operations of aircraft. However, due to the absence of sufficient guidelines and/or standards for conducting and/or evaluating an aeronautical study, it is difficult to consistently and analytically identify the effect of the obstacles on aviation safety.

Additionally, due to the absence of a uniform procedure for the conduct and content of an aeronautical study, there might be elements missing in the analysis which are relevant to operations and the unexpected consequences associated with those elements.

It has been acknowledged that there are different applications of aeronautical studies worldwide. In some cases there is a proliferation of aeronautical studies while in other cases there is a complete lack of them. Aeronautical studies can be of long duration and expensive and there might be a lack of objectivity in performing these assessments due to a lack ofsufficient technical and operational justification guidance and potential biased assessment.

3.7 Impact of existing requirements on implementation and operations

The management of obstacles at and in the proximity of an aerodrome must ensure the safe and efficient use of the aerodrome environment. Annex 14 surfaces do not specifically take into account the operations required for aerodrome long term planning. This has resulted in it becoming increasingly difficult and costly for aerodrome operators and States to justify airspace protection limits.

The OLS might be too restrictive in relation to operations at some aerodromes or not sufficiently restrictive at other aerodromes. For example, aerodromes might not have visual circuit operations due to the density and nature of their operations and have no flexibility to alter the relevant portion of the OLS. In this situation the justification for imposing all surfaces and controlling obstacles issue was addressed through the revision of ASM Part 6 but guidance lacks the “teeth” for global application. It is anticipated that the proposed concept, with additional guidance in PANS Aerodromes, will address this situation.

4 The new concept

4.1 Objectives of the new concept

The new concept for the revision of Annex 14 OLS, shall meet the following objectives:

- Clarify the purpose of the surfaces
- Consistency with current and future aircraft capabilities
- Consistenncy with operations
- Be applicable and efficient

4.1.1 Clarify the purpose of the surfaces

The purpose of each surface shall be identified in terms of:

- Stringency for safety, regularity or efficiency

- Nature/type of operations protected

- Hazards and operational factors taken into consideration and documented in an appropriate manner in Annex 14 and its supporting documentation.

4.1.2 Consistency with current and future aircraft capabilities

The aircraft approach speed categories will be used instead of the aeroplane reference field length[1] for the differentiation of OLS.

The revision of the OLS shall account for improved performances of modern aircraft and will adjust the OLS characteristics based on data. For example, aircraft certification criteria (e.g. crosswind limits), flight track data and other statistical evidence. Legacy aircraft will be accommodated as a result of the use of approach speed categories.

4.1.3 Consistency with operations

The shape and characteristics of the proposed obstacle surfaces shall be consistent with and support PANS OPS criteria and the current and future operations at the aerodrome.

4.1.4 Be applicable and efficient

The revised specifications shall not impose unnecessary constraints on non-aviation developments and must be supported by a documented justification balanced between aerodrome and aircraft safety, accessibility and capacity and external economic, social and environment considerations.

The revised specifications shall provide the means for implementation through standards and recommended practices in Annex 14 and procedures in the PANS Aerodromes. The states will also require structured training support, particularly in the area of aeronautical studies.

4.2 Basic principles of the new concept

4.2.1 Introduction

The first principle is to keep Annex 14 provisions simple and use PANS Aerodromes to ensure harmonized application worldwide.

The second principle is a revised system consisting of three sets of complementary surfaces: the Obstacle Free Surfaces (OFS), the Obstacle Evaluation Surfaces (OES) and the Structure Height Restriction Surface (SHRS).

The third principle is the protection of the airspace for the intended flight operations

The fourth principle is to ensure the adequacy and proportionality of the application of surfaces to the current and long term operations at the aerodrome. For example:

- limiting the requirements to what is strictly necessary;
- making a clear distinction between what is necessary for safety, accessibility and efficiency;
- ensuring that future aircraft performance and navigation capabilities can be accounted for;
- egiving States some flexibility to extend the requirements.

This new framework will provide tangible benefits to the existing and future system. It will allow aerodrome operators and States to have standardized requirements which could be enacted in local zoning or ordinances and used to justify protection limits. At the same time, the framework provides sufficient flexibility to account for a continuously changing environment, to ensure an increased level of performance and to unlock built-in constraints that are no longer necessary.

[1] The ADWG TF is currently reviewing the relevance of the aerodrome reference field length for design characteristics.

The strength of this concept is that while providing a set of harmonized requirements, it allows States to identify their own priorities and establish the best and most suitable application of those requirements based on their operational environment. This represents a significant paradigm shift that provides fundamental changes in the basic concepts and established practices of the obstacle management discipline whilst improving safety.

Obstacle control surfaces are necessary to ensure that the existing and planned aeroplane operations at the aerodrome are able to be conducted safely and to prevent the aerodromes from becoming unusable. The two following sets of surfaces are intended to meet this purpose.

4.2.2 OFS

The Obstacle Free Surfaces are surfaces that are applied within a defined airspace to be maintained free from obstacles.

The purpose of the OFS is to protect and ensure the safety and durability of the instrument procedures inside the OCA/OCH, departure, balked landing and non-instrument runway operations.

The philosophy behind the OFS:

- The OFS shall not have penetrations, except for special considerations for existing terrain and obstacles
- The OFS shall include and replace the existing the OFZ;
- In the area currently described in Annex 14 as the OFZ, the OFS bounds the airspace which is not penetrated by any equipment or installation required for air navigation or for aircraft safety purposes shall be frangibly mounted and as low as possible.
- There will be a series of tables (to replace Table 4-1 and Table 4-2) that define a surface or a set of surfaces associated with aeroplane operations;

Note: States must either have legislative powers to prevent construction of obstacles that would penetrate an OFS or establish a process for aeronautical studies for proposed penetrations.

4.2.3 OES

The Obstacle Evaluation Surfaces are additional surfaces that are applied in a defined airspace, below and beyond the OFS, to be evaluated against obstacles.

The purpose of the Obstacle Evaluation Surfaces is to act as a trigger for an aeronautical study which will evaluate the potential impact of obstacles to planned or existing aeroplane operations outside the OFS.

The philosophy behind the OES:

- The OES complements the OFS;
- The OES identify surfaces above which terrain or obstructions must be assessed (by an aeronautical study) to determine the potential adverse impact to the operations. The penetration may be acceptable when after the aeronautical study it is determined that the object would not adversely affect the safety or significantly affect the regularity of operations of aeroplanes;
- The OES supports aircraft operator development of non-normal procedures;
- The OES accounts for modern PBN procedures (consistent with the Global Air Navigation Plan);
- There will be a series of tables (to replace Table 4-1 and Table 4-2) that define a surface or a set of surfaces associated with the aircraft operations (minima and approach type).

4.2.4 SHRS

The Structure Height Restriction Surface (SHRS) specifies a maximum height limit for structures inside the aerodrome boundary, other than specific functions such as control towers.

4.2.5 The third principle is the protection of the airspace for the intended flight operations

The OFS should not protect more than a volume necessary to protect the safety and regularity of operations of a given aerodrome. For example, the slope of the approach OFS should be linked to the types of operations on the runway.

Comment [WY8]: Not clear as to wh it really means.

The safety and regulatory criteria for the acceptance of an obstacle shall be specified in guidance in the PANS Aerodromes.

4.2.6 Use PANS Aerodromes to ensure harmonized application world wide\

The fourth principle is to ensure the adequacy and proportionality of the application of surfaces to the current and long term operations at the aerodrome.

PANS Aerodromes will:

- Provide guidance for State regulations regarding obstacles and for the application of OFS-OES at aerodromes.
- specify procedures for the control of obstacles by aerodrome operators and other parties
- Provide rational justification to support States in their Zoning/Urban planning decisions.
- Provide detailed guidelines for the review, conduct and/or evaluation of Aeronautical studies.

4.2.7 States to have the alternative to extend the requirements

Annex 14 and supporting provisions in the PANS Aerodromes will give States the alternative to extend the requirements.

The new concept allows:

- States to make the OES, or parts thereof, as an OFS;
- States to adjust the OES to support a specific operation.

4.2.8 Treatment of existing penetrations

The new OFS are, in general, narrower, shorter and have steeper slopes. When the new surfaces are implemented, some terrain or structures that penetrate current surfaces might no longer penetrate the OFS. Where they do, existing aeronautical studies or other assessments of those remaining penetrations should be reviewed to validate the existing mitigation strategies.

Description and characteristics

4.2.8.1 **Approach Surfaces**

Concept and purpose

The approach surface will retain the basic concept of the existing approach OLS and will encompass the inner approach surface from existing Obstacle Free Zone (OFZ). The approach surface will be divided into an OFS and an OES.

OFS

The approach OFS is based on US aircraft track data.~~ with containment to a probability of 1x 10~~$^{-7}$. This results in ~~a~~ proposed OFS approach slopes ~~of~~ shown in table 4-1~~3.5%~~ with containment to a probability of 1x 10^{-7}.

In the event that the approach OFS cannot be achieved due to terrain and/or existing obstacles, an aeronautical study would then be conducted to determine the ~~feasible slope~~impact of the penetration and possible mitigation actions. Possible options available to the State following this study include:

- ~~Limit the impact of future obstacles and C~~Consider ~~any further~~ the impact on instrument flight procedures. This ~~may~~ could result in a higher approach procedure(s) slope or the need to displace the threshold.
- Remove the terrain/obstacle ~~to re-establish the proposed 3.5% slope~~.

Comment [WY9]: It's a big change from the existing 2%. 10^{-7} is used for PANS-OPS when evaluating operational risks, but for Annex 14 surfaces (of permanent nature) should we be a bit more conservative?

Comment [AE10]: This is consistent with the protection for PANSOPS procedures and is supported by track da

Comment [WY11]: Do we allow aeronautical study for OFS?

Comment [AE12]: Yes, see the adde text to paragraph 4.2.2.

OES

The approach OES can be either generic or specific to the instrument flight procedures available at the aerodrome.

The generic approach OES is intended to be simpler for States to establish but will not likely provide the optimal minima at most aerodrome locations for all instrument flight procedures types.

The generic OES dimensions in the revised Annex 14 table will provide a set of example minima for the different instrument flight procedure types. The generic approach OES will be based upon two airspace concepts:

- An approach OES surface, located below the approach OFS and with a wider inner edge, which is intended to provide containment for 3D approach procedures;
- A sector of the Horizontal Surface, based upon PANS OPS circling minima, which will provide partial containment for 2D instrument flight procedures.

The Annex would then state that if minima below the nominal are required/desired, the specific OES would then be required in order to establish and then protect the actual PANS OPS surfaces for existing and proposed instrument flight procedures.

The details and process for establishing a specific approach OES will be documented in PANS Aerodromes.

Note: The proposed OFS and OES would also account for approaches to non-instrument runways.

4.2.8.2 Transitional Surfaces

Concept and purpose

The Transitional surface will retain the basic purpose of the existing transition and approach surfaces. ~~approach OLS and~~ It will ~~encompass~~ replace the existing inner transitional surface ~~from~~ and the OFZ. ~~It will consist of an OFS and an OES related to the approach surface.~~

OFS

The transitional surface will disconnect the transitional surface from the overall runway strip width. The new transitional surface will encompass the overflight requirements under all operational conditions based on US flight track data.

Note: A separate task will need to be raised through the Aerodrome Design Working Group in order to review the width of the flyover area and the overall runway strip.

The transitional surface will originate at 75m from the runway centreline and will follow the elevation of the runway. It will rise vertically to 15m and will then continue at a slope of 1:7 (14.3%) before terminating at the final height. The final height of the transitional OFS will be raised to 60m in order to protect balked landings and descents through the Decision Altitude (DA) under all operational conditions.

Comment [WY13]: Bear in mind thi contradicts the existing 150 m width requirement for each side of the runwa strip and will have an impact on other SARPs in the Annex (e.g. Chapter 3 and Chapter 9). Do we need a back-up plan? (i.e. base the proposal on the existing 15 m width)

Comment [AE14]: Protection of airspace and protection of RWY veer off areas are separate matters.

~~**OES**~~

~~Refer to the approach OES.~~

4.2.8.3 Horizontal Surfaces

Concept and purpose

The Horizontal surfaces will retain the basic purpose of the existing inner horizontal and conical surfaces. It also considers the outer horizontal surface as recommended in Part 6 of the Aerodrome Services Manual.

The basic concept of the Horizontal Surface is based on visual circling requirements in PANS OPS, for aerodrome altitudes up to 3000 ft[2], and is consistent with Part 6 of the Aerodrome Services Manual.

The Horizontal surface will only consist of an OES specific to aircraft approach speed categories. It is intended to protect circling, circuits, approaches, departures and terminal instrument flight procedures.

OES

All approach speed categories A – E have been included:

Note: Category E is not typical to civil use.

[2] ICAO PANS OPS Vol II, Chapter 7 based on a 3000' aerodrome height AMSL.

- Category A: To a distance of 3.2km at 45m above aerodrome elevation.
- Category B: To a distance of 5.1km from the reference point at 60m above aerodrome elevation.
- Category C: To a distance of 8.2km from the reference point at 60m above aerodrome elevation.
- Category D: To a distance of 10.3km from the reference point at 90m above aerodrome elevation.
- Category E: To a distance of 13.5km from the reference point at 90m above aerodrome elevation.

Comment [WY15]: Why 3.2km?

Comment [AE16]: Consistent with Annex 6.

The reference point for the Horizontal Surfaces is the runway centreline and the runway strip end(s) with the outer edges joined tangentially. The surfaces and intended to be conjoined to the extent the largest approach speed category.

The Horizontal Surface can replace part of the extended take-off climb surface when a turn is required in the departure procedure.

Note: Visual circuit operations for low performance aircraft are protected by the 45m Category A surface. This is currently protected by the inner horizontal surface (of the OLS) which extends out to 4000 m at a height of 45 m above aerodrome elevation. The current IHS is intended to protect circuits at speeds up to 120kts. The category B circuits at 60m AGL at 5.1km radius would protect circuits at 135 kts.

The Horizontal Surface OES is intended to be flexible in application. The full Horizontal Surface should be established at the aerodrome, appropriate to the intended aircraft approach speed category, however states have the option to:

- Reduce the size of the Horizontal surface if either circuits or circling are not available at the aerodrome;
- Eliminate sectors of the Horizontal surface if circuits and circling are not available at the aerodrome if a full approach and take-off climb surfaces is provided.
- Use a corresponding sector of the Horizontal Surface to protect turning departures in lieu of the full take-off climb surface (out to 10,000m).
- Make all or portions of the Horizontal OES as an OFS;
- Partially implement the Horizontal surface in sectors;
- ~~Increase the minimum height of the Horizontal surface;~~
- Vary the minimum distance of the Horizontal surface in accordance with PANS OPS protection requirements.

Note: Consideration should also be given to providing sectors to fully protect PANS OPS including surfaces required for approaches and departures.

Guidance on the adjustment of the Horizontal Surface will be provided in PANS Aerodromes.

4.2.8.4 Take-off climb surfaces

Concept and purpose

The take-off climb surface will reflect the purpose of the existing take-off OLS. It will consist of an OFS and an OES.

The OFS is based on US aircraft track data with containment to a probability of 1x 10^{-7} (verified by the French DGAC).

The OES is a two part concept based on Annex 6 and PANS OPS requirements.

OFS

The OFS intent is to provide protection against close in obstacles.

For the OFS, the origin height is based on PANS OPS criteria while the inner edge is based upon aircraft track data. The final length and standards are based on:

- For approach speed categories A and B: The slope is based on current Annex 14 OLS criteria which is aligned with Annex 6 Part II. This has been retained as no evidence has been presented that 5% is unsatisfactory and lowering the slope would be an unsubstantiated imposition on aerodrome operators. The length is based on potential close in obstacle penetrations (according the PANS OPS criteria);
- For approach speed categories C and D: Based on PANS OPS criteria for a nominal climb gradient of 3.3% to an altitude of 400' (which provides an obstacle identification surface of 2.5%).

The take-off surface commences a 5m above DER, aligned with PANS OPS and Annex 6 requirements.

The specifications of the Take-off climb surface OFS are contained in the table in Appendix A.

In the event that the take-off climb surface OFS ~~cannot be achieved~~is penetrated due to terrain and/or existing obstacles, an aeronautical study would then be conducted to determine the ~~feasible slope~~appropriate mitigation. Possible options available to the State following this study:

- ~~Limit the impact of future obstacles and~~C~~c~~onsider ~~any further~~ impact on any ~~instrument flight~~departure procedures. This could result in a higher take-off ~~slope~~ climb gradient and/or reduced Take Off Distance Available (TODA);
- Remove the terrain/obstacle ~~to re-establish the desired/optimum slope~~.

Comment [WY17]: Again are we allowing aeronautical study for OFS?

Comment [AE18]: Yes. Refer to the text added to paragraph 4.2.2.

Comment [WY19]: Should this be restricted or at least not encouraged?

Comment [AE20]: No. This is curren practice.

OES

For the OES, the two part concept will be introduced. The first concept is based upon Annex 6 Parts I and II. The specifications for the surface are based upon aircraft wingspan and type of operation. The second concept provides PANS OPS protection in addition to the Annex 6 based surface. This ensures that the obstacle environment is assessed for instrument departures where applicable as determined by the State.

The specifications of the Take-off climb surface OES are contained in the table in Appendix A.

4.2.8.5 **Balked Landing surface**

Concept and purpose

It is important to retain the existing Balked Landing surface which forms part of the existing OFZ. The dimensions will be adjusted based on the new Transition Surface in order to form a new OFS for balked landings. This provides protection for all instrument runways rather than for just CAT II/III precision approaches.

The specifications of the balked landing surface are contained in the table in Appendix A.

4.2.8.6 ~~**Aerodrome**~~ **Structure Height Restriction Surface**

Concept and purpose

A new concept of a~~n~~ "~~Aerodrome~~ Structure Height Restriction Surface" is proposed. It is intended to be independent of the OFS and OES concepts. Its purpose is to establish a structure height limitation, as a replacement for the inner horizontal surface, within the aerodrome property boundary to cover portions of airspace not covered by the OFS. ~~or OES or which would present a hazard to aircraft operations.~~

Characteristics:

The lateral limit is within the continuous aerodrome property boundary.

All structures are to be restricted to a maximum height of 45m above the aerodrome elevation or to the height of the OFS at the boundary of the aerodrome, whichever is lower.

Any structures whose locations are fixed by aeronautical function (e.g. ATC towers) are exempted.

4.2.8.7 **Approach lighting OES**

Concept and purpose

The Approach lighting OES replaces the inner approach OFZ whose purpose is to protect the approach lighting system from any obstructions which would obscure the visibility of the system. The existing Annex 14 values have been retained. The surface is an OES rather than an OFS due to the variability of lighting systems and operational requirements. It is proposed to apply this surface generically to any approach lighting system, design, alignment, size and type regardless of operation.

The nominal specifications of the approach lighting OES are contained in the table in Appendix A. States have the option to ~~vary~~ lower the OES based on the light lane installation and the requirement for protection.

4.2.9 Requirements

The requirements for obstacle free surfaces are specified on the basis of runway type, i.e. non-instrument and instrument (non-precision approach, precision approach), on the approach guidance accuracy (lateral accuracy only), the type of operations, i.e. visual or instrument (type A, type B) and approach speed category.

4.3 Aeronautical Studies

Draft material from the OLSTF (2012)/OLSTF 1-2 will be expanded and implemented within PANS Aerodromes to support the concept.

APPENDIX A

Surfaces Tables

Changes to PANS OPS and other related documents will be required to reference these tables.

Obstacle Free Surfaces (OFS)

Obstacle Free Surface (OFS)								
RWY type	**non-instrument RWY**		**non-precision approach RWY**				**precision approach RWY**	
approach guidance accuracy (lateral)	**-**		**non-LP procedures**		**LP procedures**			
approach type	**-**		**Type A (≥ 250 ft MDH/DH)**		**Type A (≥ 250 ft MDH/DH)**		**Type B (< 250 ft MDH/DH)**	
approach category	**A-B**	**C-D**	**A-B**	**C-D**	**A-B**	**C-D**	**A-B**	**C-D**
APPROACH SURFACE								
length of inner edge	*60 m*	*150 m*	*150 m*	*150 m*	*150 m*	*150 m*	*150 m*	*150 m*
distance from threshold	A 30 m B 60 m	60 m	60 m	60 m	60 m	60 m	60 m	60 m
divergence (each side)	10%	10%	10%	10%	10%	10%	10%	10%
Length **Minimum length. For angles higher than standard 3^0, refer to PANS Aerodromes procedure.*	*A 2000 m* *B 2500 m*	*3000 m*	*4300 m*	*4300 m*	*4300 m*	*4300 m*	*4300 m*	*4300 m*
Slope * **Minimum slope. For angles higher than standard 3^0, refer to PANS Aerodromes procedure.*	*A 5%* *B 4.0%*	*3.5%*	*3.5%*	*3.5%*	*3.5%*	*3.5%*	*3.5%*	*3.5%*
TRANSITIONAL SURFACE *Same width as the inner edge of the approach surface.*								
slope	20%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%	14.3%
Initial height	-	-	15 m	15 m	15 m	15 m	15 m	15 m
OFZ - BALKED LANDING SURFACE								
length of inner edge	-	-	150 m	150 m	150 m	150 m	150 m	150 m
distance from threshold	-	-	1800 m*	1800 m*	1800 m*	1800 m*	1800 m*	1800 m*
divergence (each side)	-	-	10%	10%	10%	10%	10%	10%
Slope	-	-	3.5%	3.5%	3.5%	3.5%	3.5%	3.5%

Obstacle Free Surface (OFS)		
Take off runways		
Approach category	**A - B**	**C - D**
Take-off climb surface		
length of inner edge	~~*90*~~ *120 m*	~~90~~ 120 m
Initial height above DER	5 m	5 m
Origin	DER	DER
divergence (each side)	~~10%~~15 degrees (27%)	~~10%~~15 degrees (27%)
Length	*1,700m*	*3,500m*
Slope	*5%*	2.5%

Note: Values to be reviewed against flight track data.

Obstacle Evaluation Surfaces (OES)

Obstacle Evaluation Surface (OES) 3D Approach
TO BE DETERMINED

Approach Lighting OES	
Width **The width of the approach lighting system.*	120 m or 155 m*
distance from threshold	60 m
Length **The length of the approach lighting system.*	900 m*
Nominal slope	2.0%

Obstacle Evaluation Surface (OES)					
Horizontal Surface					
approach category	**A**	**B**	**C**	**D**	**E**
HORIZONTAL SURFACE					
Distance from centreline or midpoint of inner approach baseline (joined tangentially)	3.2 km	5.1 km	8.2 km	10.3 km	13.5 km
Height above aerodrome elevation	45 m	60 m	60 m	90 m	90 m

Obstacle Evaluation Surface (OES)			
Take off runways			
	Based on Annex 6 Part 2 *Applicable to all runway used for:* • *Non commercial operations;* • *Non jet operations; and* • *Aircraft below 5700kg MTOW*	**Based on Annex 6 Part 1** *Applicable to all other operations.*	**Based on PANS OPS** *Applicable to instrument departures in addition to the Annex 6 based surface*
ARC code (wingspan)	**A-F**	**A-F**	**All approach categories.**
Take-off climb surface			
length of inner edge	*A/B 60 m* *C 80 m*	*A/B 144 m** *C-F 180 m** **From either side of centreline, 60m + 0.5 times wingspan, limited to 180m maximum*	300 m
Height of inner edge above DER	*N/A*	*N/A*	5m
Outer width	*A/B 660 m* *C 830 m*	1200m * **For heading changes less than 15^0* 1800m** ***For heading changes more than 15^0*	N/A
Origin	End of Take Off Distance Available (TODA)	End of Take Off Distance Available (TODA)	End of Take Off Distance Available (TODA)
divergence (each side)	10 %	12.5%	1^{st} segment: 15^0 (26.8%) 2^{nd} segment: 30^0 (57.8%)
Length	*A/B 3000m* *C 3750 m*	*10,000m*	1^{st} segment: 3500m 2^{nd} segment: 6500m (to be validated)
Slope	*A/B 5%* *C 4%*	*1.6%*	2.5%

Aerodrome Structure Height Restriction Surface	
AERODROME STRUCTURE HEIGHT RESTRICTION SURFACE *Within the continuous property boundary of the aerodrome. May be extended by the State if required.*	
Height above aerodrome elevation	45m