Amendment of AC 29-2C

Introduction

For an extensive period, the International Federation of Helicopter Associations (IFHA), as a member of the ICAO Heliport Design Working Group (HDGW), has attempted to bring to the attention of Authorities and Manufacturers the existence of a safety hazard due to the misinterpretation of Part 29, and its associated guidance, in the certification of Cat A procedures. This relates both to the provision of the Rejected Take-Off Distance (RTOD) – for runway and vertical type procedures, and the 'minimum elevated heliport size demonstrated' – for helipad type procedures.

With respect to the RTOD and runway type procedures; misinterpretation occurs because the applicants have failed to show, and the authority has not required, compliance with guidance in Part 29 which calls for containment of all parts of the helicopter when the dimensions of the RTOD are established. With respect to heliport design and operations, the RTOD of a Category A procedure should correspond (exactly) with the FATO. No changes to AC 29 are proposed but compliance with the current wording in the standard and guidance is necessary to restore its intent.

With respect to vertical take-off helipad procedures (where a helipad is a ground level or elevated FATO which may support multi-directional approaches and departures); it is likely that misinterpretation has resulted from a belief that, when establishing minimum dimensions, only the landing surface (in ICAO terms the TLOF) and visual cues need to be considered – i.e. there appears to be doubt as to whether the requirement for the RTOD (and hence the FATO), specified in 29.1587 and 29.62, applies to helipad procedures.

A Description of the Issues

The members of the ICAO HDWG have become aware of serious safety issues arising from their work on ICAO Annex 14, Volume II – i.e. an inability to establish a 'deterministic' safe distance from obstacles for helicopters operating from/to Performance Class 1 heliports. This arises because:

1. Safety of operations in Performance Class 1 - using Category A (Cat A) Procedures - is dependent upon the provision of a deterministic, and adequate, distance of all parts of the helicopter from obstacles;
2. the provision of Standards for Performance Class 1 heliports in Annex 14, Volume II, is based upon the assumption that minimum Cat A dimensions in Rotorcraft Flight Manual Supplements (RFMS) are provided in accordance with Annex 8 and, by inference, Part 29 and its associated advisory material;
3. compliance with Part 29 and its associated advisory material is intended to ensure that the minimum dimensions for Cat A includes containment of all parts of the helicopter during the rejected take-off or One-Engine-Inoperative (OEI) landing procedures;
4. States and Agencies are accepting dimensions in the RFMS which are not compliant with the provisions of Part 29 and its associated advisory material because they do not provide containment, and therefore do not provide a means to determine obstacle clearance;

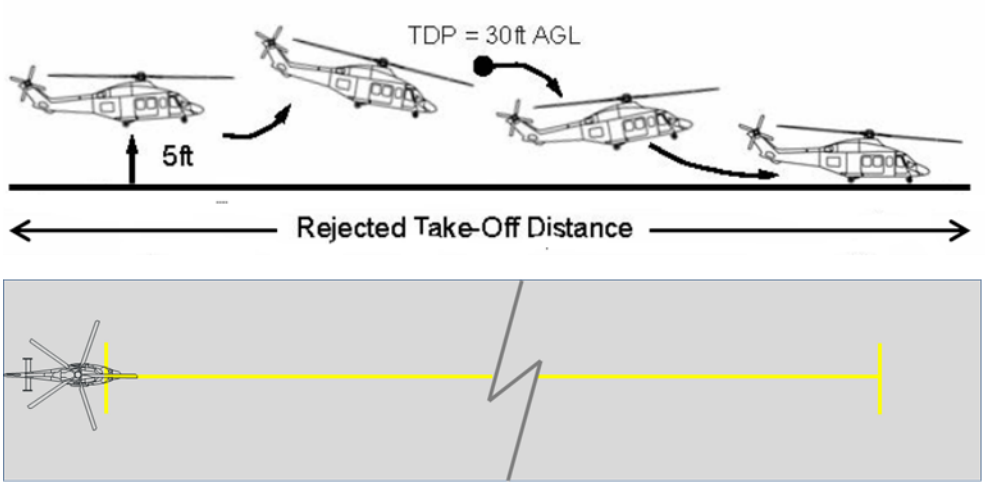
5. Performance Class 1 heliports are being designed, built and approved on the basis that Cat A dimensions in the RFMS include complete containment - from which provision for adequate distance from obstacles can be established;
6. examination of the content of a number of RFMS has established:
    a. that provision of the Rejected Take-off Distance (RTOD) is <u>not always</u> in accordance with Part 29 and its associated advisory material, in that not all elements of the helicopter are included in the distances provided;
    b. the principle dimension being provided for ground level and elevated 'helipad' procedure is the 'minimum elevated heliport size demonstrated' which does not include containment and, in a number of cases, is currently less that the overall length of the helicopter;
    c. in one RFMS, the "…minimum surface dimension for a helipad with a perimeter obstacle <u>at or above the main rotor height</u>" is 15m in diameter – when the overall length of the helicopter is in excess of 13m.

<u>The Provision of the RTOD</u>

Because of these potentially unsafe situations, two distinct actions are proposed: the first, an instruction to ensure that certificating staff are made aware of the requirement for containment when approving procedures within the RFM or RFMS; and the second, an amendment of the guidance to make clear that the RTOD is equally applicable to vertical procedures (including for a helipad). These are described below:

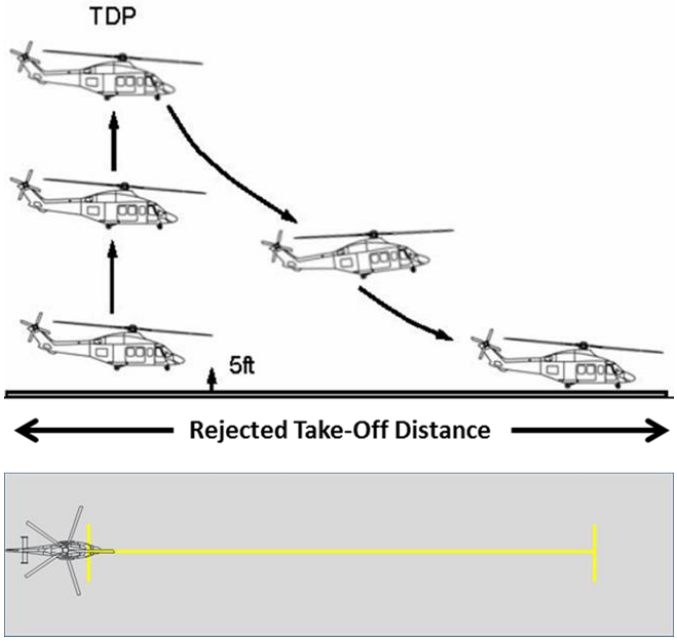
1. Certificating Staff should be made aware that the RTOD for any Cat A procedure should be in compliance with AC 29.59A paragraph a (3):

    "…The rejected takeoff distance is normally measured at a given reference point on the rotorcraft from the start of the take-off to the same reference point after the rotorcraft has come to a complete stop. <u>This distance should be increased by the rotorcraft length (including main and tail rotor tip paths)</u>."

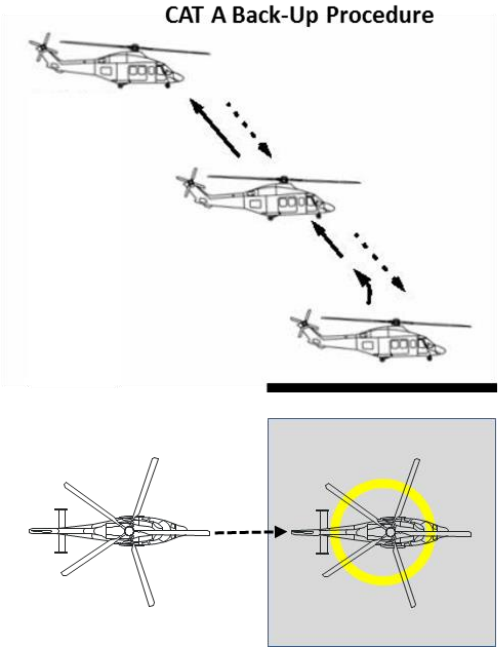


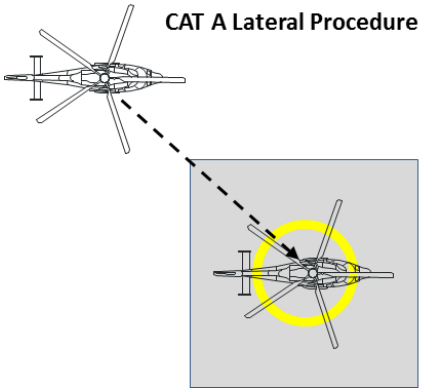
2. Whilst there is adequate advice for the vertical takeoff which includes a run-on (as shown in the diagram below) in the current advisory material in AC 29.59 paragraph b (12)(iv)(A):

> "…Establish the rejected takeoff distance as the horizontal distance from the rearmost point of the rotorcraft at the initiation of takeoff to the foremost point after the rotorcraft comes to a stop on the takeoff surface (including rotor tip path), assuming an engine failure in the vertical climb at the TDP."



Additional clarity is required to enable applicants to establish the appropriate RTOD for vertical procedures when they are part of a back-up or lateral procedure (both shown below):





In these two cases it might clearer if the existing wording in AC 29.59A paragraph b (12)(iv)(A):

> …Establish the rejected takeoff distance as the horizontal distance from the rearmost point of the rotorcraft at the initiation of takeoff to the foremost point after the rotorcraft comes to a stop on the takeoff surface (including rotor tip path), assuming an engine failure in the vertical climb at the TDP.

was augmented with an appropriate wording more suited to the conduct of the helipad procedure - based upon the wording in AC 29.59A paragraph a (3):

> For helipad procedures:
>
> …Establish the rejected takeoff distance as the minimum area into which a rejected takeoff can be carried out, assuming an engine failure in the vertical climb to the TDP. This area should provide containment of all elements of the rotorcraft.

Landing Provisions for Helipad Procedures

(The following proposal is based upon the contents of ICAO Discussion Paper – HDWG/8 – DP/01 an extract of which is shown in Appendix B)

With respect to vertical landing procedures and the provision of the 'minimum elevated heliport size demonstrated' (which, as explained above, is usually the only dimension provided for the ground level or elevated helipad procedure) IFHA have flagged a serious safety issue because the Standards of ICAO Annex 6 & 14 (and State's operational codes) rely upon the nomination of a minimum dimension which ensures containment of the complete helicopter. In short, safety Standards are dependent upon provision of a dimension compliant with AC 29.59A b (3) and/or 29.59A b (12)(iv)(A).

This is not an insoluble problem provided it is accepted that there are two imperatives in play - each of which need to be satisfied:

1. The perceived need for manufacturers to provide the smallest footprint for Cat A 'helipad' procedures as currently shown in the Rotorcraft Flight Manual Supplement (RFMS) – this

will establish dimensions for undercarriage containment (effectively the TLOF in ICAO terms) and the required visual cues for the procedure.

2. The requirement for manufacturers to ensure helicopter containment by providing a RTOD satisfying AC 29.59A a (3) and/or 29.59A b (12)(iv)(A) – this will establish the FATO dimensions for the procedure.

Both of these imperatives can be satisfied even though existing flight manuals may, at this time, contain only the 'minimum elevated heliport size demonstrated'. Because the difference between the undercarriage plus visual cues and tip path of the main rotors or the rearmost part (of each type of helicopter) is known, there is nothing that would prevent the manufacturer from performing a simple calculation and providing the FATO size as an additional dimension in the Cat A Supplement. This would also allow States, which permit the TLOF to be smaller than the FATO for an elevated site, to use both measurements in the provision of surfaces, and obstacle clearance.

This has already been discussed with the FAA Rotorcraft Directorate and has led to the proposal for the amendment of AC 29.75A (b)(2)(viii) shown in the text below.

> (viii) Vertical Landings. The reader should be familiar with the preceding discussion of conventional Category A, landing profiles because duplicate information is not repeated here. A typical vertical landing profile is shown in figure AC 29.75A-2. This profile is equally applicable to both ground level and elevated heliport sites…
>
> …The minimum elevated heliport size demonstrated for the OEI approach procedure and for alternate AEO approach procedures (when provided) should also be provided in the Flight Manual. **This minimum elevated heliport size represents the sum of (1) the size of the pad required to contain the undercarriage of the rotorcraft, (2) the aircraft performance scatter during OEI landings to a specific reference point, and (3) the distance required to provide the minimum suitable visual cues for a safe OEI landing.**
>
> **It should also be noted that the minimum demonstrated size does not necessarily guarantee rotor containment. The minimum rotorcraft containment area is defined as the larger of either a) the minimum demonstrated heliport size or b) the overall length of the helicopter (including main and tail rotor tip paths) plus the performance scatter seen in the heliport size determination. If the minimum rotorcraft containment area is larger than the minimum demonstrated heliport size, the minimum rotorcraft containment area should also be provided in the RFM.**

Proposal for Amendment of AC 29-2C

Proposed changes to AC 29-2C

1. An addition to AC 29.59A paragraph b (12)(iv)(A);
2. An amendment to AC 29.75A (b)(2)(viii).

Regulatory Impact Assessment

These changes address AC material only and will have no significant impact. The proposed changes are necessary in the interest of safety to restore the intent of Part 29 to provide rotorcraft containment whenever the Rejected Take-off Distance (RTOD) is required to be included in the RFM or RFMS. This will ensure that heliports can be designed, and heliport operations can be conducted, with the assurance that distance from obstacles is as intended in ICAO Annexes 6 and 14 (and a State's operational codes - where they exist).

Proposed Amendment

The text of the proposed amendment is arranged to show deleted text, new text or new paragraph as show below:

(a) deleted or amended text is shown with a strike through: ~~deleted~~

(b) new or amended text is highlighted with grey shading: new

(c)… indicates that remaining text is unchanged in front of or following the reflected amendment.

Proposal

Proposal 1: Amend AC 29.59A paragraph b (12)(iv)(A) to append the highlighted text:

For helipad procedures:

Establish the rejected takeoff distance as the minimum area into which a rejected takeoff can be carried out, assuming an engine failure in the vertical climb to the TDP. This area should provide containment of all elements of the rotorcraft.

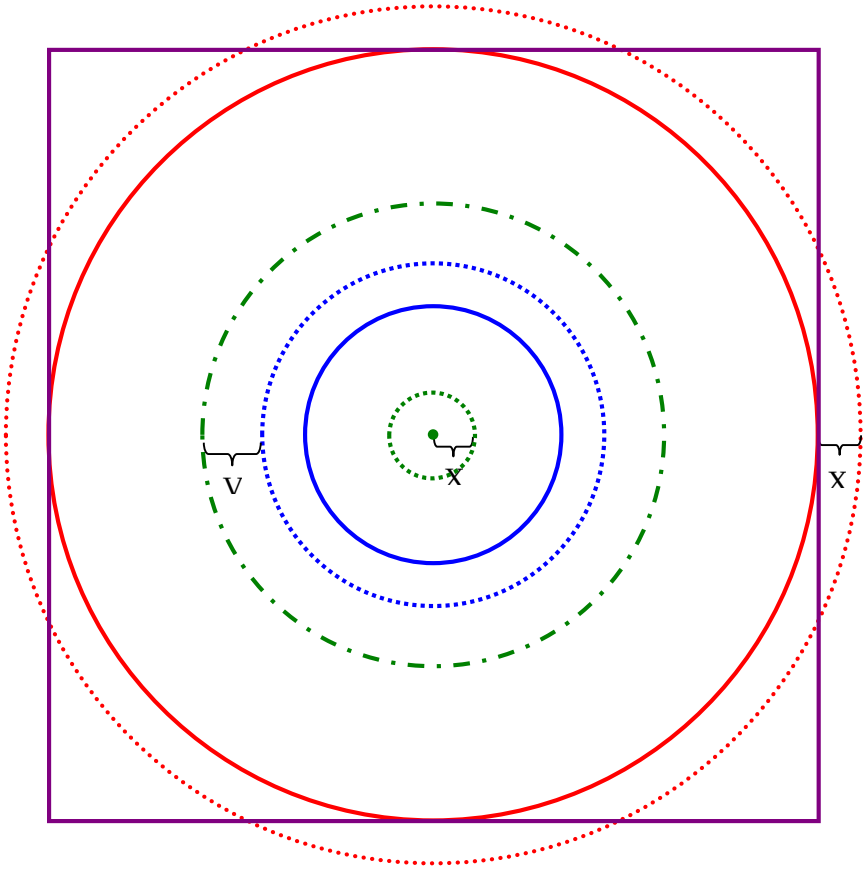
Proposal 2: Amend AC29.75A (b)(2)(viii) to append the highlighted text:

(viii) Vertical Landings. The reader should be familiar with the preceding discussion of conventional Category A, landing profiles because duplicate information is not repeated here. A typical vertical landing profile is shown in figure AC 29.75A-2. This profile is equally applicable to both ground level and elevated heliport sites...

…The minimum elevated heliport size demonstrated for the OEI approach procedure and for alternate AEO approach procedures (when provided) should also be provided in the Flight Manual. This minimum elevated heliport size represents the sum of (1) the size of the pad required to contain the undercarriage of the rotorcraft, (2) the aircraft performance scatter during OEI landings to a specific reference point, and (3) the distance required to provide the minimum suitable visual cues for a safe OEI landing.

It should also be noted that the minimum demonstrated size does not necessarily guarantee rotor containment. The minimum rotorcraft containment area is defined as the larger of either a) the minimum demonstrated heliport size or b) the overall length of the helicopter (including main and

tail rotor tip paths) plus the performance scatter seen in the heliport size determination. If the minimum rotorcraft containment area is larger than the minimum demonstrated heliport size, the minimum rotorcraft containment area should also be provided in the RFM.



Physical Dimensions

Undercarriage Containment Area (UC) /Width/ Length

Rotorcraft Overall Length (D)

'Reference' area of 1D

Touchdown Reference Point

Performance/Measured Information

Touchdown Performance Scatter (Aircraft Reference Point Scatter – 2X)

Undercarriage 'containment area' plus 2 time the Touchdown Performance Scatter

Minimum Elevated Heliport Size Demonstrated (AC 29-2C Para 29-75(b)(2)(viii) – includes UC + 2 times Visual Cues (2V) plus 2 times Touchdown Performance Scatter (2X))

Minimum Rotorcraft Containment Area (MRCA) – Overall Length (D) plus the Touchdown Performance Scatter (2X)

(Extract from ICAO Discussion Paper – HDWG/8 – DP/01)

APPENDIX H – ESTABLISHING THE REJECTED TAKE-OFF DISTANCE

The ICAO HDWG, were tasked to address the revision of Annex 14 Volume II. In doing this they had to be mindful of the fact that it is one of an integrated set of Annexes (6, 8, 14) all based, initially, on the work of the ICAO Helicopter Operations Panel ('Heliops'), and introduced as a means of including appropriate provision for helicopters.

In Annex 8, helicopter provisions were introduced into the Eighth Edition in 1988. This stated that the data, scheduled in the helicopter flight manual, is intended to be used to "provide a safe relationship between the performance of the helicopter and the aerodromes heliports and routes on which it is capable of being operated".

FAR/CS 29.1587, reflecting the Standard of Annex 8, contains the requirement:

> "For each Category A rotorcraft, the rotorcraft flight manual must contain a summary of the performance data including data necessary for the application of any applicable operating rule, together with the descriptions of the conditions, such as airspeeds, under which this data was determined, and must contain…
>
> (4) The rejected take-off distance determined under 29.62 and the take-off distance determined under 29.61;
>
> (5) The landing data determined under 29.81 and 29.85;"

In simple terms, for the establishment of a Cat A rejected take-off area, the test pilot flies a number of trial flights of the 'defined profile' to establish the landing scatter. Plotting the points established in the scatter, and adding the dimensions of the helicopter, will result in the minimum size[1] that achieves containment. From AC 29.59A(a)(3):

> …The rejected takeoff distance is normally measured at a given reference point on the rotorcraft from the start of the take-off to the same reference point after the rotorcraft has come to a complete stop. This distance should be increased by the rotorcraft length (including main and tail rotor tip paths)[2].

…and for vertical take-offs, from AC 29.59A(b)(12)(iv)(A):

> …Establish the rejected takeoff distance as the horizontal distance from the rearmost point of the rotorcraft at the initiation of takeoff to the foremost point after the rotorcraft comes to a stop on the takeoff surface (including rotor tip path), assuming an engine failure in the vertical climb at the TDP.

With respect to the 'helipad' procedure, even for a powerful helicopter and a profile where the aiming point is kept constantly in view (for example the Bell 429 procedure), this cannot result in a (minimum) FATO size of 1D (to achieve that an average pilot would have to reject and land with pin-point accuracy every time). The minimum size will depend upon the profile and the installed

[1] The final determination of the rejected take-off distance should be the aggregation of a minimum of five satisfactory runs by the Certificating Authority pilot plus the trial runs conducted by the company.

[2] Examination of flight manuals has established that not all manufacturers comply with this guidance, in some manuals the dimension of the helicopter are added to the RTODR, in others they are not.

OEI power – the less violent the manoeuvre and the slower the descent, the more likely that the pilot can spot the landing with 'reasonable' accuracy.

The data arising from the landing scatter must also take account of undercarriage configuration. With a 'helipad' procedure[3], this will require that landings in all directions be taken into consideration in the provision of the minimum size. As can be seen from Figure H-1, the S76 has an undercarriage that is completely ahead of the mid-point of the helicopter; this will result in an absolute minimum undercarriage containment area of 0.63D. To this must be applied the landing scatter - applicable in a 360° context, before adding the dimensions of the helicopter. It is expected that the minimum size will be expressed as a circle with a diameter that provides the necessary helicopter containment.

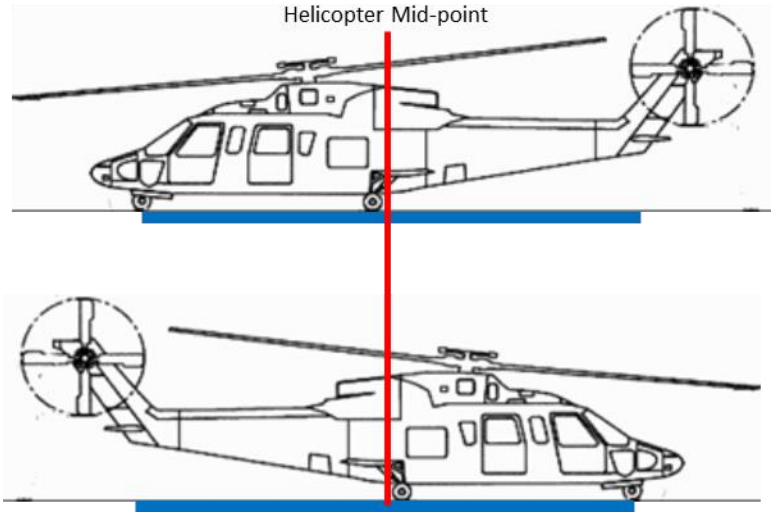


Figure H-1 – S76 showing the absolute minimum undercarriage containment area

It would appear that, for a number of years, manufacturers have declared, in the flight manual, a 'minimum elevated heliport size demonstrated' that is not directly associated with helicopter containment. From discussions, it has been established that this dimension is that required only for containment of the undercarriage[4] and the provision of adequate visual cues**.**

This leaves the 'design' and 'operational' communities in a regulatory quandary because the Standards of ICAO Annex 6 & 14 (and State's operational codes) rely upon the nomination of a RTOD which ensures containment of the complete helicopter. In short, safety Standards are dependent upon compliance with AC 29.59A b (3) and/or 29.59A b (12)(iv)(A).

This is not an insoluble problem provided it is accepted that there are two imperatives in play - each of which need to be satisfied:

3. The perceived need for manufacturers to provide the smallest footprint for Cat A 'helipad' procedures as currently shown in the Rotorcraft Flight Manual Supplement (RFMS) – this will establish dimensions for undercarriage containment (effectively the TLOF in ICAO terms) and the required visual cues for the procedure.

[3] For the heliport where an approach departure would allow operations to be conducted in any direction.
[4] For an approach flown along a single axis.

4. The requirement for manufacturers to ensure helicopter containment by providing a RTOD satisfying AC 29.59A a (3) and/or 29.59A b (12)(iv)(A) – this will establish the FATO dimensions for the procedure.

Both of these imperatives can be satisfied even though existing flight manuals may, at this time, contain only the 'minimum elevated heliport size demonstrated'. Because the difference between the undercarriage plus visual cues and tip path of the main rotors or the rearmost part (of each type of helicopter) is known, there is nothing that would prevent the manufacturer from performing a simple calculation and providing the FATO size[5] as an additional dimension in the Cat A Supplement. This would also allow States, which permit the TLOF to be smaller than the FATO for an elevated site, to use both measurements in the provision of surfaces, and obstacle clearance.

[5] The increase in size would have to take account of the original scope of the trial flights. If the 'minimum elevated heliport size demonstrated' was not predicated on a multidirectional approach policy, it would have to be considered before the dimensions of the helicopters were added.