Australian Government
Civil Aviation Safety Authority

ANNEX A TO AC 133-02 V2.1

Performance Class 2 with exposure operations - Rotorcraft type specific AMC

February 2025

Contents

Acknowledgement of Country

The Civil Aviation Safety Authority (CASA) respectfully acknowledges the Traditional Custodians of the lands on which our offices are located and their continuing connection to land, water and community, and pays respect to Elders past, present and emerging.

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1 Performance Class 2 with exposure operations

1.1 Purpose of this Annex

1.1.1 The purpose of this Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a Part 119 exposition or a Part 138 operations manual for PC2 with exposure (PC2WE) operations in the following aircraft:

- AW139 rotorcraft
- Bell 412EP rotorcraft
- BK117 B-2, BK117 B-2 fitted with the LTS101-850B-2 powerplants, and BK117 C-2 (EC-145) rotorcraft
- EC135 P2 rotorcraft
- A109E rotorcraft.

1.2 Structure of this Annex

1.2.1 The AMC material for the specific aircraft listed above are separated in this annex.

Notes:

1. As aircraft configurations and installed equipment vary, the information, calculations and performance data presented for each type of rotorcraft mentioned in this annex must confirmed by the operator as appropriate and accurate for the purposes of their operations for that aircraft type, in the configuration it is operated.
2. Where possible CASR terminology or ICAO terminology is used in this Annex. However, as it is used in many rotorcraft flight manuals (RFM), the term "helipad" is also used within this Annex in the context of its general meaning in aviation terms of - "a place where a single rotorcraft can take off and land". Depending on its use within the manufacture's RFM, it may represent (within the context of ICAO heliport terminology), the touch down and lift off area (TLOF), the final approach and take-off area (FATO) or a collocated FATO/TLOF for the purposes of the procedure being described.
3. Although sections of this Annex are written as AMC for direct transfer into company expositions or operations manuals, operators must ensure that the related AMC material is inserted in the relevant sections of their documentation. For example, whilst the AMC is included in a single chapter per aircraft for simplicity, some AMC is performance policy and administrative information, and other AMC is preflight planning, risk assessment and aircraft specific flight procedures. As such, these will need to be integrated into the appropriate section of operator expositions or operations manuals.

2 PC2WE operations Leonardo AW139 rotorcraft

2.1 Purpose of this section

2.1.1 The purpose of this section of the Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a Part 119 exposition or a Part 138 operations manual for PC2 with exposure (PC2WE) operations in the AW139. Noting that PC2WE operations are not mandatory for Part 138 operations. This will allow an AOC or Aerial Work Certificate holder to satisfy CASA of the PC2WE regulatory requirement if they choose to use and follow this Annex. However, they may also propose alternative means of compliance to the AMC proposed here if they so desire. This alternative means will need to be assessed and found acceptable for the purpose by CASA.

2.1.2 Operators and flight crew members should develop an understanding of the performance class system, as detailed within AC 133-01 Performance Class Operations (AC133-01) and AC 133-02 Performance Class 2 With Exposure Operations (AC133-02), prior to reading this Annex.

2.1.3 In addition to the sections in this Annex on PC2WE, and if applicable to their operations, operators are required to detail the procedures for use during PC1, PC2 (without exposure) and PC3 operations in their exposition or operations manual. Guidance on what is required for these operations is contained within AC 133-01.

2.1.4 To maximise the benefit of PC2WE, by keeping exposure times within limits, operators should encourage heliport operators to keep take-off and approach path obstacle-free gradients as low as possible. Failure to achieve this may mean PC2WE is not a viable option at that heliport.

2.1.5 The following sections 3 to 5 are written as AMC for direct transfer into company expositions or operations manuals for an AW139 operator. However, for simplicity, they are based on application of a limited number of Category A procedures and exclude the use of ‘drop-down’ procedures below the level of a helideck. Some operators, including offshore operators, may need to develop additional or replacement exposition material to cater for the specifics of their AW139 operations.

2.1.6 The policy of having no engine failure exposure risk from critical infrastructure is a limitation proposed by the example set out in the AMC of the Annex, however this is not a mandatory requirement for operators. Operators may propose alternative procedures to those suggested in sub-sections 5.8 and 5.9.

2.1.7 In addition to the AMC provided in this Annex, operators should consider providing pilots with simplified tables or an electronic method for determining the required performance data so as to avoid potential error with using RFM charts.

2.1.8 Section 6 provides some guidance on how to develop the risk assessment for PC2WE operations in the AW139.

2.1.9 In this document, reference is made to the Part 133 MOS; however, such referencing is not considered mandatory for an exposition or operations manual, with an expectation that referencing AC133-01 and AC133-02 (as applicable) will be sufficient for pilots.

3 AMC for Company Policy for AW139 PC2WE operations

3.1 Background

3.1.1 For maintenance of appropriate operational capability, the company has a requirement to conduct PC2WE operations.

3.1.2 Company approval to conduct PC2WE operations is predicated on achieving and maintaining CASA requirements for:

- a target level of safety
- engine reliability assessment
- continuing engine reliability assurance
- mitigating airworthiness procedures, and
- mitigating operational procedures and training.

3.1.3 As part of the CASA approval process for PC2WE operations, the company has also completed an Operational Risk Assessment for PC2WE operations. This can be referenced at (insert company manual reference).

3.1.4 PC2WE can allow greater operational flexibility for operations at higher weights, particularly to and from heliports with more complex obstacle environments. From runway environments, PC2WE offers no weight advantage over PC2 because PC2WE HOGE weight limits are more limiting than CAT A runway requirements.

3.1.5 To maintain PC2WE safety risk at an appropriate level, CASA AC 133-02 provides guidance to operators and pilots on how to risk manage such operations. For a deeper understanding of PC2WE operations, company pilots should become familiar with CASA AC 133-02.

3.1.6 AW139 performance figures used are based on an aircraft certified up to 6,800 kg or 7,000 kg and equipped with PT6C-67C powerplants. They are considered to have no EAPS or IBF engine air inlet filtering systems, and no heater or automatic environment control systems operative during take-off or landing procedures. Pilots must note that configurations that vary from that described above will require different performance figures to what is mentioned in these sections.

3.1.7 In consideration of achieving simplicity in operations and training for PC2WE, company pilots are limited to the following RFM Supp 12 Category A procedures:

- Part A – Ground level and elevated heliport / helideck vertical take-off procedures
- Part D – Confined area take-off procedures
- Part F – Clear area take-off procedures
- Part G – Heliport landing procedures
- Part H – Confined area landing procedures
- Part J – Clear area landing procedures.

3.1.8 The company Training Manual details the additional flight crew training and checking requirements for the procedures described within this section. Before using PC2WE in line operations company flight crew members must complete and been found competent in accordance with the training and checking manual PC2WE requirements outlined therein.

3.1.9 Although PC1 and PC2 operations should be conducted wherever operationally possible, PC2WE is the minimum standard for the following types of operation (regulation 133.335 of the CASR):

- Passenger transport operations with MOPSC of 10-19
- Passenger transport operations under night VFR or IFR
- Medical Transport operations (compliance with a performance class is not mandatory at a Medical Transport Operating Site (regulation 133.315), provided such operations are conducted in accordance with this exposition). The main utility for PC2WE in Medical Transport operations will be to / from hospital heliports where Category A procedures cannot be flown.

3.2 AW139 relevant characteristics and assumptions

3.2.1 The overall length (D-value) for the AW139 is 16.62 m, but for simplicity assumed to be 17 m. This is relevant for the dimensions of the heliport FATO and Safety Area. A heliport of insufficient size to meet PC2 requires PC2WE operations.

3.2.2 The rotor radius (R) for the AW139 is 6.9 m, but for simplicity assumed to be 7 m. This is applicable for defining the area to survey beyond DPATO for take-off path obstacles.

3.2.3 Because PC2WE operations do not mandate the use of Category A procedures, targeted selection of the various RFM Category A procedures and associated performance are used by the company to achieve PC2WE compliance. From these, the following assumptions may be made for the company operating environment, and they are summarised in Table 1 below:

- For any RFM Clear Area, Heliport / Helideck or Confined Area Category A take-off or landing procedure, 400 m is the worst-case OEI take-off or baulked landing distance required. The 400 m may either be available horizontally directly from the take-off point, or it can be created as a virtual clearway from a raised incline plane (for more information pilots may refer to CASA AC 133-01, sections 6.4 and 6.5).
- For any Clear Area Category A or B landing procedure, 400 m is the worst-case OEI landing and braking distance required.
- For any vertical heliport / helideck take-off when below the CAT A weight limit, OEI height loss from TDP is 20 ft. A TDP for this procedure that is any higher than 70 ft will require PC2WE.
- For any confined area take-off or landing below the CAT A weight limit, OEI height loss from TDP / LDP is 85 ft. PC2 or PC2WE operations are not permitted if the TDP or LDP for the procedure is required to be any higher than 300 ft above the heliport (180 ft obstacle). Refer to Part 133 MOS, section 10.06, for further information.
- For any clear area or heliport landing below the respective CAT A weight limit, OEI height loss from LDP is 35 ft.

Table 1: AW139 standard performance figures

Scenario	Standard figure
CAT A Clear Area, Heliport / Helideck / Confined Area worst case take-off or baulked landing distance required.	400 m
CAT A or B Clear Area worst-case landing plus braking distance required.	400 m
Height loss from CAT A Vertical Heliport / Helideck TDP.	20 ft
Height loss from CAT A Confined Area take-off or landing LDP.	85 ft

Scenario	Standard figure
Height loss from CAT A Clear Area or Heliport landing LDP.	35 ft

3.3 Maximum permitted exposure time

AMC for Part 133 MOS, section 10.11.

3.3.1 Current engine reliability data from Leonardo Helicopter Division for the AW139 allows approved rotorcraft a maximum permitted exposure time of 36 seconds, based on the rotorcraft meeting or exceeding an engine power loss rate of 0.25:100,000 hours.

3.3.2 Pilots are to ensure that the take-off and landing techniques used for PC2WE require no more than 36 seconds of exposure. If this is not possible, the PIC must take steps to reduce weight and / or adopt alternative techniques such that the maximum exposure time is not exceeded.

3.4 PC2WE limitations & performance charts

AMC for Part 133 MOS, section 10.12.

3.4.1 This sub-section details company operating limitations, and relevant performance charts for PC2WE, including those for determining take-off weight limitations to meet the requirements of section 10.12 of the Part 133 MOS. The company will provide pilots with extracts of the relevant charts (or tabulated / computerised data), as per Table 2 below, for determination of PC2WE performance.

Table 2: RFM performance chart reference

Limitation	< 6,400 kg	6,400-6,800 kg
97% HOGE Limit	Figure 9-117	Figure 9-119
1.9% gradient to 1,000 ft using MCP at 80 KIAS OR 8.0% gradient if using 2.5 min power & 50 KIAS	Supp 12, Figure 4K-10 Figure 9-109	Supp 50, Figure 4-88 Supp 50, Figure 4-64
If over populous areas - 8.0% Gradient to 1,000 ft	Supp 12, Figure 4F-15	Supp 50, Figure 4-64
50fpm OEI ROC at MCP	Figure 4-42	Supp 50, Figure 4-41
Flyaway Height Loss (Can source from Flight Management System)	Figure 4-43	Supp 50, Figure 4-37
Rejected Take-Off Distance Required	Supp 12, Figure 4F-4	Supp 50, Figure 4-54

3.4.2 Category A Weight-Altitude-Temperature limitation charts are not included for discussion in this section as they are more specifically applicable to PC1 and PC2 operations. However, operations within the CAT A heliport / helideck or confined area weight limits will help to reduce the exposure risk.

3.4.3 PC2WE is more weight limiting than PC2 operations if using clear area take-off techniques. This is because a requirement of PC2WE is to ensure the aircraft is capable of AEO hover out of ground effect (HOGE) performance that allows an acceleration from a vertical climb into forward flight. The company does not consider that the Take-Off Power HOGE weight limit provides sufficient power margin to achieve this. To ensure sufficient AEO HOGE performance, pilots must ensure that the maximum aircraft weight for PC2WE operations is not greater than 97% of the AEO HOGE weight limit at Take-Off Power with rotor speed at 102% Nr. This weight limit is normally more limiting than the OEI rates of climb requirements mentioned below.

3.4.4 Pilots must ensure that, for PC2WE operations, the aircraft weight at take-off or landing is no greater than that required to achieve an OEI rate of climb of 150 fpm (which equates to 1.9% at 80 KIAS) 1,000 ft above the heliport. As an alternative, 50 KIAS at 2.5 min power will give performance advantages provided 1,000 ft can be achieved within the 2.5 min at 400 fpm (8%). In these calculations, wind benefit must not be applied.

3.4.5 For example, for a take-off at 6,400 kg and 40°C at 4,000 ft; an 80 KIAS MCP OEI climb gives only 1.9% (150 fpm), but a 50 KIAS 2.5 min OEI climb gives over 10% (500 fpm).

3.4.6 To provide additional OEI power margins and reduce risk over populous areas, pilots must also ensure that, for company PC2WE operations over populous areas, the aircraft weight at take-off or landing is no greater than that required to achieve a 50 KIAS OEI rate of climb at take-off power of 8.0%, at 1,000 ft above the heliport. In these calculations wind benefit must not be applied.

3.4.7 For example, this is still achievable at 6,400 kg and 40°C at 4,000 ft (also refer to CASA AC 133-02, section 2.9.2 for more information on this policy).

Note: AC 133-02, section 2.9.2, indicates that 8.0% is not mandatory; however, the company has incorporated this into the standard operating procedures as a safety enhancement.

3.4.8 Pilots must ensure that, above the lower of DPATO / DPBL or 300 ft, the OEI gradient of climb is greater than or equal to the take-off path obstacle-free gradient (also known as the Obstacle Limiting Surface (OLS) gradient). OLS gradients for commonly used heliports are indicated in the company helipad register. Otherwise, they should be calculated as described in sub-section 4.3 below.

3.4.9 As for PC1 and PC2, the OEI MCP rate of climb at the minimum altitude must be at least 50 fpm. The minimum altitude for Day VFR and NVIS flight is 1,000 ft, and for night unaided or IFR flight is LSALT or MSA.

For example, 50 fpm is achievable up to 6,800 kg and 28°C at 6,000 ft, so this should rarely be a limiting factor for company AW139 operations.

3.4.10 The aircraft Flight Management System FLYAWAY HEIGHT LOSS data and RFM procedures may be used for take-off or hovering height loss information when the heliport / helideck or confined area CAT A height loss cannot be applied. This information gives an indication of when a flyaway is possible, so it may be used to determine the DPATO for PC2WE operations. In these calculations, wind benefit must not be applied.

For example, height loss from a hover at 6,600 kg and 30°C at 2,000 ft is 125 ft.

3.4.11 When conducting runway or open area operations, pilots must confirm that the rejected take-off distance required is less than the available hard, smooth, level, surface suitable for a rejected take-off. If the reject distance is longer than the available distance, PC2WE is required. However, this also means weights may need to be limited as per the HOGE requirements mentioned above.

3.4.12 When operating from elevated heliports and helidecks built on top of critical infrastructure or occupied buildings, pilots must not, for any take-off, accept an engine failure exposure risk that involves rejecting back to the building after entry into the avoid area of the HV envelope (25ft). This means a rejected take-off to the heliport or helideck must not be conducted unless within the CAT A helideck or confined area weight limits.

3.5 Suitable Forced Landing Area

3.5.1 Exposure can be avoided if usable reject or OEI landing areas can be classified as a suitable forced landing area. The area can be considered suitable if it meets the requirements for a PC2 heliport as discussed in sub-section 4.1 below, and which also equates to the RFM 'smooth, level and hard surface', as discussed under the height-velocity limitations section of the basic RFM. Pilots must assess potential suitable forced landing areas by referencing the company heliport register for a known location or on the basis of the guidance in CASA AC 133-01, section 4.1.

3.5.2 Water landing areas, when assessed as suitable by the company SMS, can also be considered as suitable forced landing areas for the AW139. The aircraft must be fitted with an approved emergency flotation system and operated in not greater than sea state 6 conditions (refer to RFM Supp 9 - Ditching Configurations). However, there must also be a reasonable expectation of rescue within survival times, and the operations be carried out in areas where search and rescue capabilities are available. For the purpose of this requirement, the company defines the boundaries of areas where SAR capability is available at (insert company manual reference) of this exposition (also refer to regulation 133.010 of the CASR).

3.5.3 Regardless of the quality of the forced landing area, it is not considered suitable for PC2 operations if an attempted OEI landing is made from inside the avoid area of the HV envelope, unless below the applicable CAT A weight limits, or during a normal angle approach. Likewise, for an area to be suitable during a clear or open area rejected take-off, the smooth, level and hard surface available (runway plus possible stopway) must exceed the RFM rejected take-off distance required (refer to Part 133 MOS, subparagraph 10.12 (f)(ii)). In the AW139, this can be up to 1,400 m, so pilots must have an awareness of this distance, particularly from shorter runways, so they can determine the need for PC2WE and the consequential reduced weights. Refer to examples of rejected take-off distance required in Table 3 below from RFM Supp 50, figures 4-54.

Table 3: Sample rejected take-off distances

Sea Level / 30°C	Rejected Take-Off Distance Required (m)
6,400 kg	100
6,600 kg	400
6,800 kg	700

3.6 Height-Velocity limitations

AMC for Part 133 MOS, section 2.02.

3.6.1 PC2WE operations are not required if entry into the avoid area is part of:

- a take-off, landing, or hover (including winching) operation at a medical transport operating site
- medical transport winch operations with OEI HOGE performance, or
- when operating within RFM CAT A limitations and procedures (as this would be PC2 at least).

3.6.2 Other than as mentioned above, any operational requirement to enter the avoid area of the height-velocity envelope during take-off will require pilots to ensure PC2WE requirements can be met, even if a suitable forced landing area is available.

3.6.3 For the AW139 at 6,600 kg, there is no applicable avoid area at 1,000 ft when less than 35° C, or at 2,000 ft when less than 24° C. Throughout the entire company operating environment, pilots can also assume they are outside of the avoid area if below 25 ft and faster than 20 KIAS (Supp 50, Figures 1-7).

3.6.4 Operations outside the avoid area will still require PC2WE operations if a suitable forced landing area is not available, or if a safe OEI flyway is not possible.

3.7 Adequate Vertical Margin

AMC for Part 133 MOS, section 10.02 & 10.30.

3.7.1 As part of the PC2WE requirements, prior to DPATO and after DPBL, pilots must fly the aircraft to avoid all obstacles by at least an adequate vertical margin.

3.7.2 The company defines 15 ft (4.5 m) as an adequate vertical margin for the AW139. However, under the following circumstances pilots must use at least 20 ft (6 m) as an adequate vertical margin:

- when the physical nature of the obstacles makes depth perception difficult
- when visibility is degraded due to precipitation, bright lights, or windshield obscurants
- at the pilot’s discretion.

4 AW139 Survey Procedures

AMC for Part 133 MOS, section 10.32(6).

4.1 Instructions for heliport survey

4.1.1 PC2WE operations could mean exposure to an OEI landing risk on a sub-standard reject area, and / or exposure to a flyaway risk. Pilots are to determine whether the proposed OEI reject area requires PC2WE.

4.1.2 Except in the case of extreme surface conditions such as swamp, marshland or heavily ploughed fields, surface strength of ground level areas never requires PC2WE, provided the size and slope are within the limits mentioned below. PC2WE operations to elevated heliports / helidecks must not be conducted above the stated weight limits for those structures.

4.1.3 PC2WE is required for any rejected take-off or OEI landing area if:

- the diameter of area is less than 34 m. This may be measured through use of mapping applications, by pacing the area, or if an airborne assessment may be based on pilot judgement and comparison with known area sizes.
- using a CAT A Clear Area take-off profile, the reject distance available is less than the reject distance required (refer to sub-section 3.4.3 above)
- the mean slope of the area is greater than 5°.

4.2 Instructions for obstacle survey

4.2.1 Pilots are permitted to conduct airborne or ground surveys of PC2 and PC2WE take-off and approach paths for determination of relevant obstacles in accordance with this sub-section (refer to Part 133 MOS, subsection 10.32(6)).

4.2.2 Surveys of certified or registered instrument runways are not required, but prior to using these runways, pilots must determine the OLS gradient and Accelerate Stop Distance Available (ASDA) from the ERSA Runway Distance Supplement (ASDA is the same as rejected take-off distance available and includes the runway length plus stopway).

4.2.3 Due to the complexity of conducting a pilot survey, where possible, pilots are to take advantage of existing heliport obstacle survey information provided in AirServices Australia documentation, or in the company heliport register for commonly used heliports. These surveys are normally compliant with a 4.5% OLS gradient from the edge of the FATO to 500 ft, within a 9° (15%) splay left and right of the FATO edge.

4.2.4 Survey information received on the same day from other company pilots may be used provided their use of the heliport was in the last 12 months.

4.2.5 Pilot surveys must only be conducted by day or at night using NVIS.

4.2.6 As discussed in section 3.2.3 above, 400 m is the worst-case take-off and baulked landing distance required. This means that, following an engine failure, it could take 400 m before the aircraft commences a climb. For this reason, a virtual clearway should be established extending 400 m from the FATO, from which point an OLS gradient can then be established. However, if conducting a vertical or confined area take-off, and obstacles are present within the first 400 m, the virtual clearway must also be raised to the level of those obstacles, this creates a raised incline plane for the OLS. This ensures that, from a TDP or rotate point, the OEI height loss still remains 35 ft (10.7m) above the obstacles, as required by the Part 133 MOS. (Also, refer to AC 133-01, section 6.4.2).

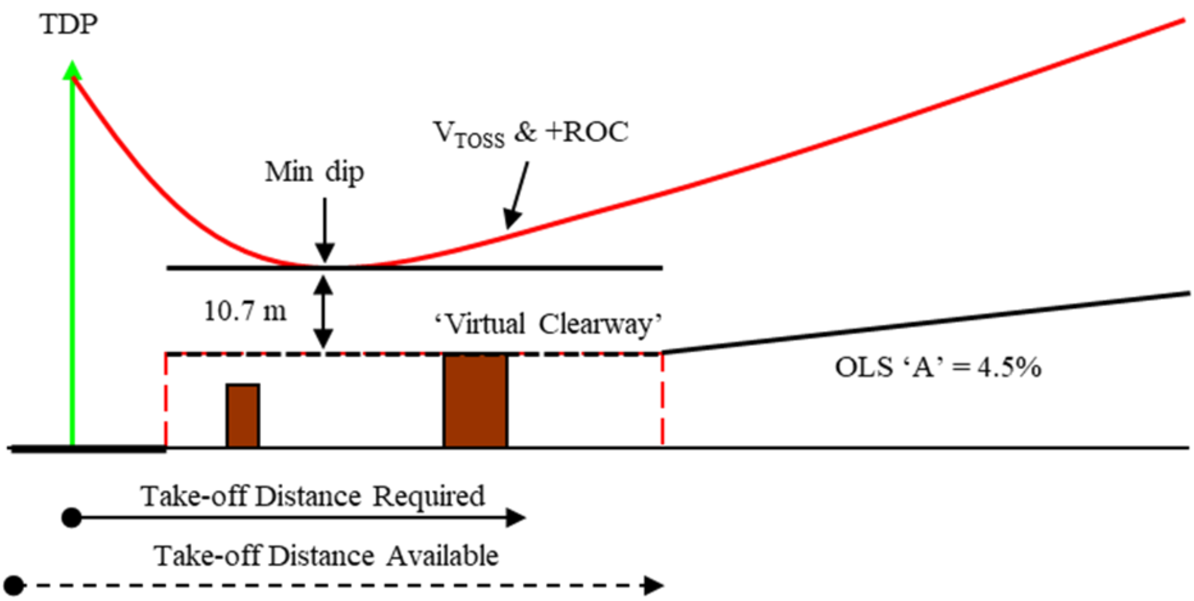

Figure 1: Raised virtual clearway

4.2.7 The virtual clearway may also be lowered when operating from elevated helidecks. A 20 ft lowering can allow the minimum CAT A vertical rotate height of 35 ft to be used from smaller helidecks where retaining visual cues present challenges. The 35 ft rotate height limit will ensure that there is no descent below the level of the helideck during a continued take-off.

4.2.8 For company operations, pilots must assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 8 km. Noting that turns are permitted to avoid obstacles, once at 200 ft above obstacles by day or on NVIS, or above 500 ft by night unaided, the unavoidable obstacle creating the steepest gradient within this area will be the limiting obstacle. If obstacles at the splay edges are of concern, the splay can be limited to a width of 70 m either side of the take-off path.

4.2.9 Determine the OLS gradient to the limiting obstacle by estimating the height above the raised incline plane, and distance from the end of the 400 m virtual clearway. Mapping applications may be used to assist, but pilots may also estimate heights based on obstacle heights of familiar features such as domestic power poles (10 m).

OLS gradient = 100 x (height of obstacle above raised incline plane) /

(distance to obstacle from end of virtual clearway)

Note: It is acknowledged that the limiting obstacle may not be visible from the helipad due to obstructions in the immediate vicinity. However, it is acceptable for a pilot to use their judgement of heights and distances based on the nature of local vegetation and terrain, and information obtained from mapping applications.

4.2.10 If the calculated OLS gradient exceeds the aircraft's OEI climb gradient to 1,000 ft, the pilot must either plan to conduct a turn back to overhead before reaching the critical obstacle or reduce the OLS gradient by further elevating the raised incline plane.

For example, an obstacle 60 m (200 ft) above the raised incline plane, and 500 m from the end of the virtual clearway produces a gradient of 12%. However, if the incline plane is raised by a further 30 m (100 ft), the new calculation would be 100 x 30 / 500 = 6%, which may be achievable by the aircraft. As mentioned earlier, any raising of the incline plane and virtual clearway will also require an upwards correction of the TDP or rotate point for any vertical or confined area take-off.

4.3 Summary of PC2WE survey requirements

AMC for Part 133 MOS, paragraph 10.28(3)(b).

4.3.1 "Helipad" diameter must be greater than 34 m and slope less than 5° to avoid exposure during any rejected take-off or OEI landing.

4.3.2 Assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 8 km.

4.3.3 Identify the highest obstacle in the splay, above or below the helipad, within 400 m. This equates to the height of the virtual clearway.

Note: Temporary obstacles, such as cranes and other temporary structures, also need to be considered.

4.3.4 Within the splay, assess the height and distance of the limiting obstacle relative to the end of the virtual clearway.

4.3.5 Calculate the OLS gradient to the limiting obstacle from the end of the virtual clearway, and ensure this is less than the aircraft OEI climb gradient to 1,000 ft (refer to Part 133 MOS, paragraph 10.12(d)).

4.3.6 Adjust the rotate point or TDP to ensure 35 ft clearance from the height of the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)).

4.4 Use of an error budget

4.4.1 Because PC2WE involves various performance calculations, plus pilot visual assessments of dimensions, slopes, heights and distances, all of which are prone to error, it is prudent to ensure there are tolerances for error. The company has the following control measures in place to ensure an appropriate margin of error is available:

- A maximum weight of 97% of HOGE means PC2WE must not be conducted above 6,600 kg.
- PC2WE must not be conducted for approaches to obstructed helipads unless a CAT A heliport approach angle can be flown to a point in space above the helipad (double-angle), or unless able to operate within the CAT A confined area weight limits and procedures.
- Wind benefit must not to be considered for PC2WE performance calculations, as this can be unreliable and adds complexity to the gathering of performance data.
- The use of a worst-case 400 m take-off distance is normally in excess of what is actually required.
- The use of an assumed 0.25:100,000-hour engine power loss rate is higher than the reported rate.

5 Flight Procedures

5.1 Take-off and landing common calculations

5.1.1 The following information must be determined prior to all take-offs and landings for the expected weights, altitude and temperature of operations. This may be done on a worst-case basis of weights, altitudes and temperatures to cover multiple take-offs and landings (refer to Part 133 MOS, paragraph 10.28 (3)(a)):

- Confirm Category A weight limits for Clear Area, Heliport / Helideck, and Confined Area.
- Confirm if the obstacle environment allows the use of the CAT A Heliport / Helideck or Confined Area procedures.
- Determine the 97% HOGE weight limit (maximum 6,600 kg). This weight is always under the CAT A Clear Area weight limit, so Clear Area performance data can be validly applied (refer to Part 133 MOS, paragraphs 10.12 (a) & (b)).
- For the take-off and baulked landing flight paths, determine the OEI climb gradient at 80 KIAS and 1,000 ft. Alternatively, confirm if it is at least 400 fpm (8.0%) at 50 KIAS and Take-Off Power (refer to Part 133 MOS, paragraphs 10.12 (c) & (f)(i); subparagraphs 10.28(3)(c)(ii) & (vi)).
- If over populous areas, confirm the OEI climb gradient at 50 KIAS and 2.5-min power is at least 8.0%.
- Conduct the take-off path survey as per sub-section 4.3 above. If turns are not planned until after the critical obstacle, ensure the OLS gradient is less than the 80 KIAS or 50 KIAS OEI climb gradient.
- Identify visually, and / or with maps, the optimal flight path to follow if OEI after DPATO or before DPBL, but only allow for turns once above 200 ft (500 ft if night unaided) (refer to Part 133 MOS, paragraphs 10.28(3)(c)(i) & (v)).
- Determine OEI rate of climb at 80 KIAS and MCP, at 1,000 ft AGL for Day VFR or NVIS, otherwise at LSALT, is at least 50 fpm (refer to Part 133 MOS, paragraph 10.12 (e); subparagraph 10.28(3)(c)(iv)).

5.2 Take-off from open areas unsuitable for a rejected take-off

5.2.1 This procedure could be used from treeless paddocks or open fields that are unsuitable for a rejected take-off. This sub-section assumes the immediate lift-off area is of a suitable size and slope for a forced landing.

5.2.2 Despite having the option of conducting this open area procedure, pilots should use the confined area or heliport procedures described later in this section if they assess the relative risk and the consequences of a rejected take-off will be lessened, even if this means a slightly higher exposure time.

5.2.3 Conduct the take-off using the CAT A Clear Area procedure. If the virtual clearway is raised, conduct the initial take-off vertically, using up to take-off power, until at the virtual clearway height, then rotate to fly the Clear Area procedure. Exposure commences from entry into any avoid area of the HV envelope (25 ft) and finishes at the DPATO of 30 ft above the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

5.2.4 If OEI after the DPATO, continue with the CAT A Clear Area OEI procedure and, if necessary, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles by at least 50 ft and climb to a safe height. Note that the AW139 loses 3% climb gradient during 15° angle of bank turns, so turns must not be conducted unless the OEI rate of climb is greater than 3% (RFM Supp 12, Figure 4K-1).

5.2.5 If OEI before the DPATO, conduct the rejected take-off procedure to land in the safest area available with minimum speed for the surface conditions.

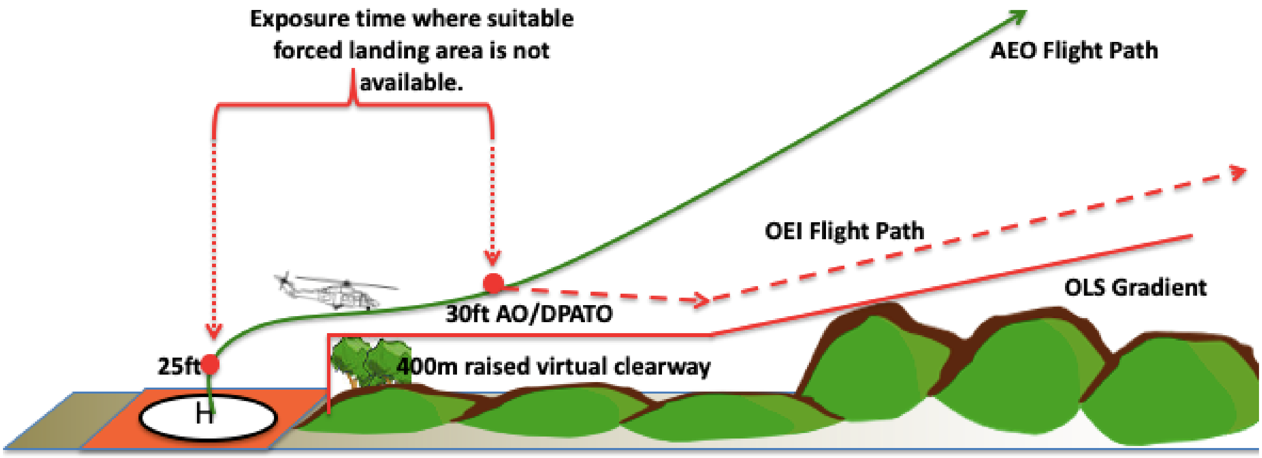

Figure 2: PC2WE open area take-off

5.3 Approach to open areas unsuitable for a run-on landing

5.3.1 This sub-section assumes that obstacles on the approach will allow the CAT A Clear Area profile to be safely flown. If not, apply the procedures for a heliport or confined area as discussed later in this section.

5.3.2 If a direct approach is possible, no exposure should be present under the PC2WE regime to a suitable helipad. With the required HOGE power margins, and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. For the clear area profile, pilots should use 50 KIAS and 70 ft above the virtual clearway as the basis for when they are “committed” to an OEI landing and can no longer achieve a safe baulked landing (Figure 3 below).

Notes:

1. 70 ft is used as the committal height, instead of 50 ft, to ensure 35 ft obstacle clearance is assured for any baulked landing (RFM assumes 15 ft obstacle clearance).
2. The assumption is that the approach will allow AEO power required to remain below OEI Take-Off Power (80% PI AEO), and so always allow the helipad to be reached.

5.3.3 If OEI before the committal point (DPBL), conduct the CAT A Clear Area baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

5.3.4 If OEI after the committal point, continue the approach to land at the helipad with minimum speed for the surface conditions.

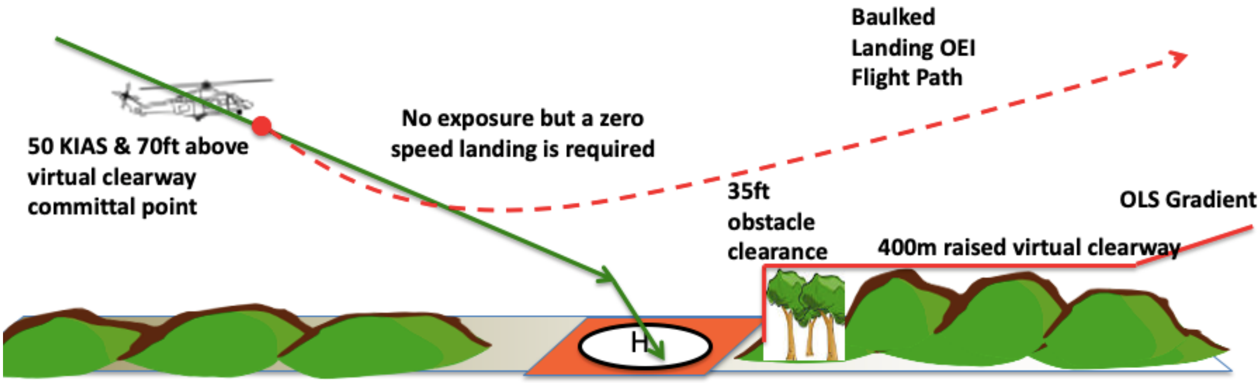

Figure 3: PC2WE open area approach

5.4 PC2WE take-offs from confined areas

5.4.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

5.4.2 Confirm the confined area allows for the CAT A Confined Area back-up procedure to be conducted. This means that, to retain an appropriate obstacle clearance for a reject, there must be no obstacles within a 15° splay higher than a 40° slope, from 25 m rear of helipad centre, back to 150 m (RFM Supp 12, Figure 4D-2). If obstacles are present and do not allow this procedure, the vertical procedures described later in this section must be applied instead.

Note: The 15° splay is a conservative splay which allows for the slight lateral movement during the confined area procedure.

5.4.3 Conduct the take-off using the CAT A Confined Area procedure. If the virtual clearway is raised, the Rotate Point (RP) and DPATO must be achievable by 300 ft above the helipad, and:

- If below CAT A weights: RP at 120 ft above the virtual clearway. Nil exposure (PC2)
- If above CAT A weights and good surrounding visual cues: Apply the vertical take-off procedure described later in this section. The vertical take-off procedure is easier to fly and involves less height loss but does require good visual cues for a rejected take-off.
- If above CAT A weights and poor surrounding visual cues: Apply power up to take-off power. RP at the Flyaway Height Loss height plus 35 ft above the virtual clearway. Exposure will be from 25 ft until the RP. Required power margins should always allow the RP to be achieved within the 36-second exposure time limit (refer to Part 133 MOS, subparagraph 54(3)(e)(ii)).

5.4.4 If OEI after the DPATO, continue with the OEI Flyaway Height Loss procedure and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

5.4.5 If OEI before the DPATO, reject the take-off to land back at the helipad.

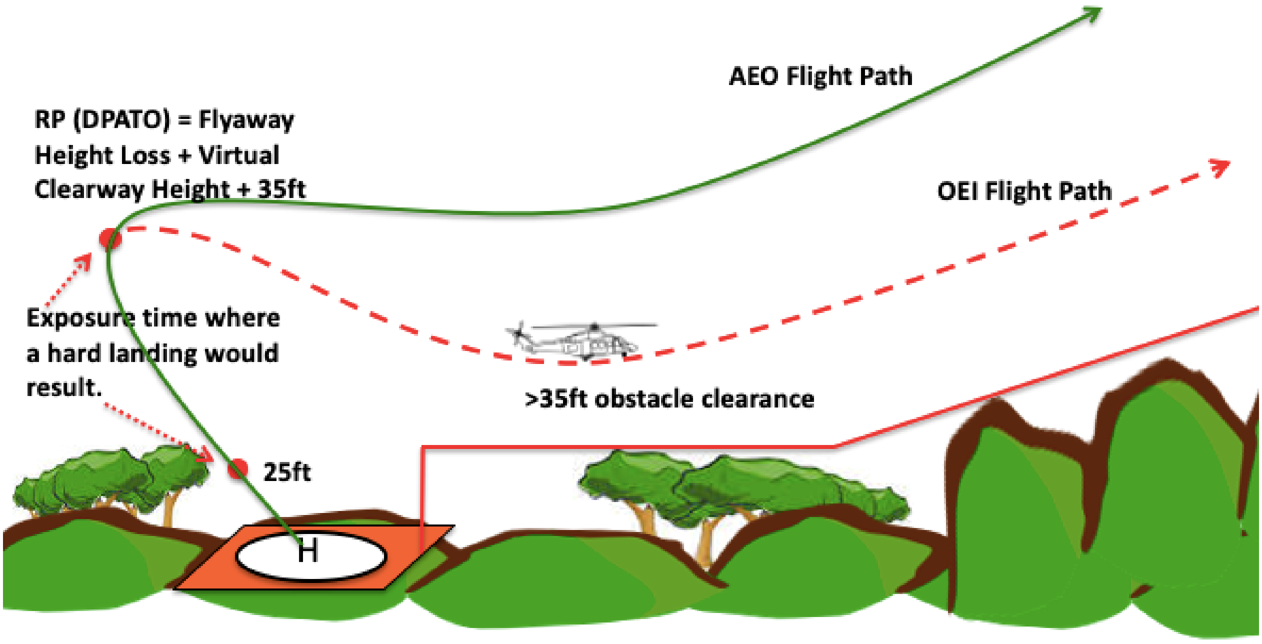

Figure 4: PC2WE Confined Area take-off

5.5 PC2WE approaches to confined areas

5.5.1 If the confined area obstacle environment allows for the CAT A Confined Area approach, and within the CAT A weight limits, PC2WE is not required as this would be PC2.

5.5.2 If above the CAT A confined area weight limit, this profile must not be flown. This is due to the steepness of the approach and excessive exposure time that is required from any DPBL. Avoid this type of landing site.

Note: Heliports that expect to be used for Air Transport operations should not be designed to require the steeper confined area profiles. Such heliports are most likely to be encountered at the medical transport operating site, where compliance with a performance class is not required.

5.6 PC2WE vertical take-offs from heliports / helidecks

5.6.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

5.6.2 These heliports / helidecks are assumed not to be on top of critical infrastructure but provide a surrounding visual cuing environment sufficient for pilot references to be maintained during extended vertical take-offs.

5.6.3 Conduct the take-off using the CAT A Vertical Heliport / Helideck procedure. If the virtual clearway is raised, the Rotate Point (RP) and DPATO must be no higher than 300 ft above the helipad, and:

- **If below CAT A weights**: RP at 55 ft above the virtual clearway. Nil exposure up to 70 ft above the heliport. Exposure from 70 ft to RP. Maximum permitted virtual clearway height is 245 ft (300 ft RP).

- **If above CAT A weights**: Apply power up to take-off power. DPATO is located at the Flyaway Height Loss height plus 35 ft above the virtual clearway. Exposure will be from 25 ft until the RP. Power margins should always allow this to be achieved within the 36-second exposure time limit (refer to Part 133 MOS, subparagraph 54(3)(e)(ii)).

5.6.4 In some circumstances, a suitable reject area may be available ahead of the take-off point. In such cases, the aircraft must not be moved forward beyond these suitable areas prior to DPATO due to the risk of a reject into an environment with more potential for a catastrophic consequence. A reject down to a relatively flat and unobstructed area is always preferable due to the lesser overall risk, and each site must be assessed on its merits for this option.

5.6.5 If OEI after the RP (DPATO), continue with the applicable CAT A Vertical or OEI Flyaway Height Loss procedure and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

5.6.6 If OEI before the RP (DPATO), reject the take-off to land back at the heliport. Take advantage of suitable forced landing areas ahead if possible.

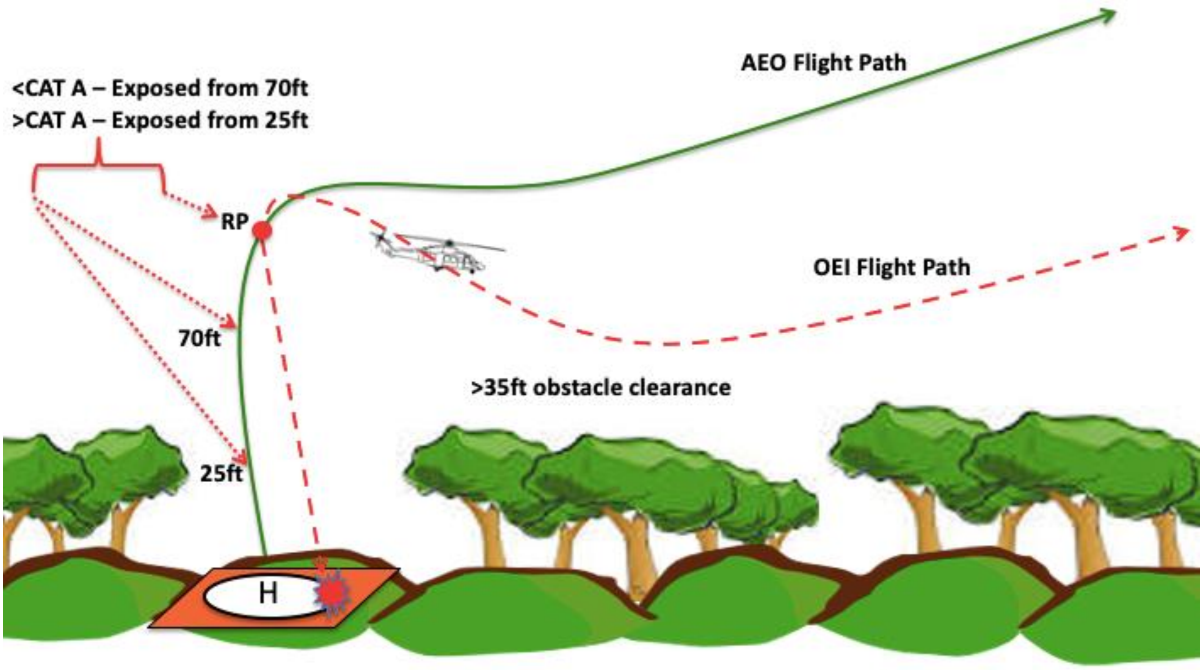

Figure 5: PC2WE Vertical take-off

5.7 PC2WE approaches to heliports / helidecks

5.7.1 This sub-section can apply to heliports where obstacles allow a direct heliport approach to the heliport / helideck, or where the obstacles do not allow either the heliport or confined area approach profiles. The difference is that, if obstacles are present, the approach will become a double-angle approach.

5.7.2 If a direct heliport approach is possible, and within the CAT A heliport weight limits, PC2WE is not required as this would be PC2.

5.7.3 If a direct heliport approach is possible, but above the CAT A heliport weight limit, no exposure should be present under the PC2WE regime. With the required HOGE power margins, and provided a normal heliport approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown on a suitable area. However, pilots must use 50 KIAS and 70 ft above the virtual clearway as the basis for when they are ‘committed’ to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the heliport approach will allow AEO power required to remain below OEI Take-Off Power (80% PI AEO), and so always allow the helipad to be reached.

5.7.4 If a direct approach is not possible and a double-angle approach is required, weights above the CAT A heliport weight limit are not permitted. A double-angle procedure could not be conducted safely within the exposure time limits if above these weights.

Note: Pilots conducting medical transport operations should be aware this prohibition does not apply at a Medical Transport Operating site.

5.7.5 If a double-angle approach is required and within the CAT A weight limits, fly the heliport procedure to a double-angle. Exposure commences at 20 KIAS and 70 ft above any virtual clearway, and it finishes at the helipad (Figure 6 below). However, double-angle approaches are not ideal for PC2WE operations due to the potential for excessive exposure times. For this reason, pilots must not conduct this approach if obstacles in the baulked landing flight path are higher than 110 ft (based on a 300 fpm rate of descent from a 180 ft DPBL).

- If OEI before the DPBL, conduct the CAT A Heliport baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.
- If OEI after the DPBL, the profile should allow continuation of the double-angle approach for a descent into the helipad to land with minimum speed for the surface conditions.

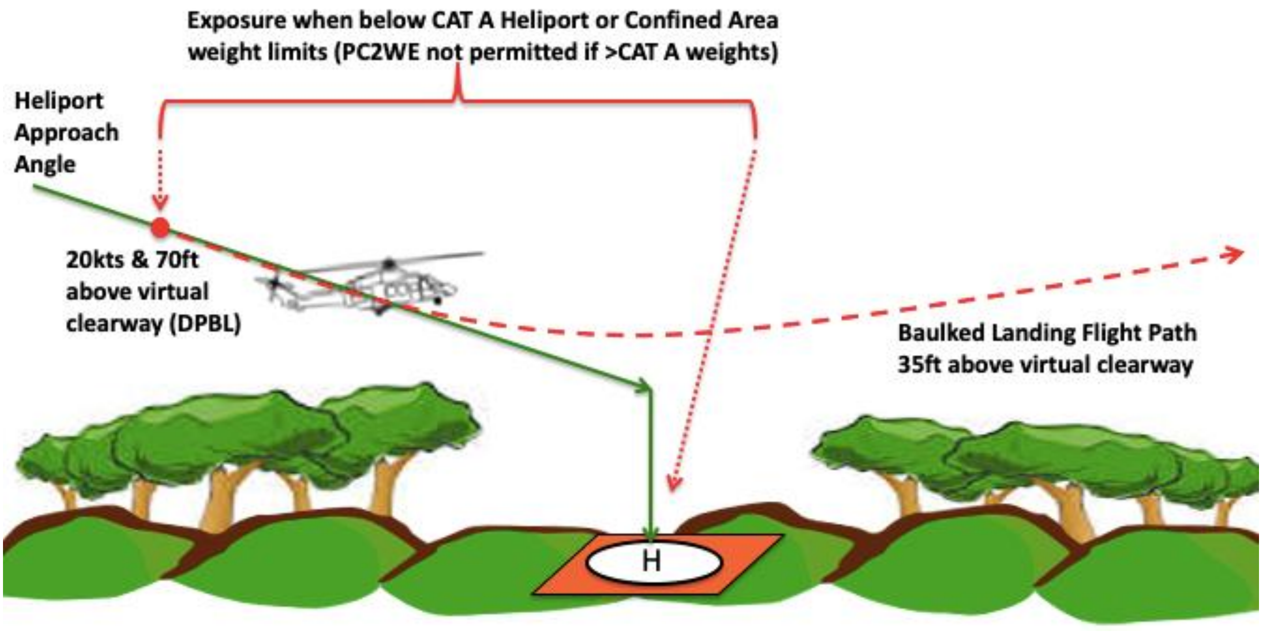

Figure 6: PC2WE obstructed heliport approach

5.8 PC2WE take-offs from elevated heliports and helidecks on critical infrastructure

5.8.1 This sub-section gives an option of lowering or raising the virtual clearway if supported by the pilot survey of a 400 m virtual clearway.

5.8.2 If applying CAT A vertical heliport / helideck weights & procedures: There is no exposure (PC2) if using a RP at least 55 ft above the virtual clearway, provided rotate points are between 35 ft and 70 ft above the helideck. If the virtual clearway needs to be higher than 15 ft (RP 70 ft), the pilot must conduct the CAT A confined area profile instead.

5.8.3 If applying CAT A confined area weights & procedures: There is no exposure (PC2) if using a RP 120 ft above the virtual clearway.

5.8.4 If above CAT A weights: This is the most critical PC2WE situation for elevated heliports on top of critical infrastructure in populous areas, where a reject back to the heliport may not be an acceptable risk:

- Review areas in the take-off path as possible emergency landing areas.
- To minimise risk of a deck-edge strike, commence the take-off from a point with the nose-wheel between 1.5 m and 4.0 m from the front edge of the heliport/helideck (recommendation from RFM Supp 97).
- Apply power up to take-off power and rotate at 25 ft. DPATO will be when the pilot judges 50 KIAS and a positive climb 35 ft clear of obstacles can be achieved OEI (DPATO). The exposure risk is from 25 ft until DPATO. Pilot judgement of DPATO will be based on their awareness of Flyaway Height Loss data, aircraft acceleration rates and height above obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

5.8.5 If OEI after the DPATO, accelerate to 50 KIAS to commence a climb and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

5.8.6 If OEI before the DPATO, and prior to 25 ft, reject the take-off to land back at the helipad. If OEI before DPATO, but after the 25 ft RP, attempt to land with minimum speed at the pre-identified emergency landing areas ahead.

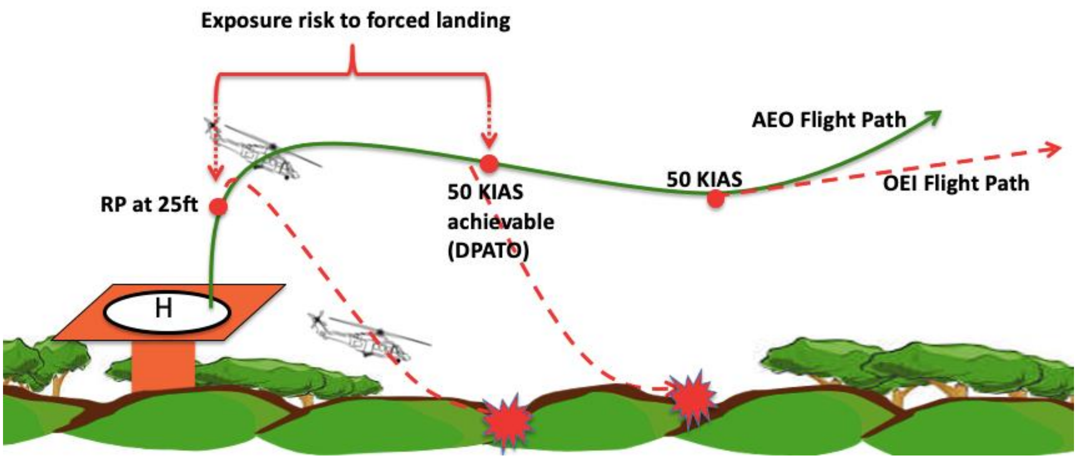

Figure 7: PC2WE elevated heliport / helideck take-off

5.9 PC2WE approaches to elevated heliports and helidecks on critical infrastructure

5.9.1 Approaches to elevated heliports and helidecks on critical infrastructure must not be conducted unless a direct heliport approach angle, without a double angle, is possible. This removes the risk of a near vertical descent and engine power loss leading to an excessively heavy landing.

5.9.2 If conducting a direct heliport approach, and within the CAT A heliport weight limits, PC2WE is not required as this would be PC2.

5.9.3 If conducting a direct approach, but above the CAT A heliport weight limit, no exposure should be present, under the PC2WE regime, for the approach. With the required HOGE power margins, and provided a normal heliport approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. However, pilots must use 50 KIAS and 70 ft above the virtual clearway as the basis for when they are committed to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the heliport approach will allow AEO power required to remain below OEI Take-Off Power (80% PI AEO), and so always allow the helipad to be reached.

5.10 Summary of PC2WE DPATO & DPBL

5.10.1 Table 4 below summarises the numbers discussed in sub-sections 5.2 to 5.9 above. In this table, ‘AO’ (Above Obstacles) is taken to mean height above the established height of the virtual clearway. The common use of 25 ft refers to the base of the avoid area of the HV envelope (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(iii) & (vii)).

Table 4: PC2WE summary of exposure

Open Areas <CAT A	Exposure starts	Exposure Finishes
Take-Off	25 ft	30 ft AO (DPATO)
Landing	Committed at 50 KIAS & 70 ft AO, but no exposure on a normal profile	
Confined Area		
Take-off >CAT A	25 ft	Flyaway Height Loss + 35 ft AO (DPATO)
Landing >CAT A	Not permitted	
Heliport / Helideck		
Vertical Take-off <CAT A (obstacles >15 ft)	70 ft	55ft AO (DPATO)
Vertical Take-off >CAT A	25 ft	Flyaway Height Loss + 35 ft AO (DPATO)
Landing direct >CAT A	Committed at 50 KIAS & 70 ft AO, but no exposure on a normal profile	
Landing double-angle <CAT A	20 KIAS & 70 ft AO (DPBL)	at helipad
Landing double-angle >CAT A	Not permitted	
Helideck (on critical infrastructure)		
Take-off >CAT A	25 ft	50 KIAS achievable (DPATO)
Landing direct >CAT A	Committed at 50 KIAS & 70 ft AO, but no exposure on a normal profile	

6 PC2WE Risk Assessments

6.1 Risk mitigation by CASA

6.1.1 CASA reviews the acceptability an operator's PC2WE operations on the basis of compliance with the requirements of the Part 133 MOS, sections 10.11 to 10.16. These are summarised as:

- a maximum exposure time of 36 seconds, with anything above nine seconds supportable by engine power loss rates proportionally less than 1:100,000 hours
- having in excess of HOGE power margins
- all rotorcraft and engine preventative maintenance actions are completed
- operator risk assessment procedures for AW139 PC2WE operations are in place, including measures to mitigate the risk (refer to 6.2 below)
- operations are conducted in accordance with the RFM and this exposition
- flight crew training and checking is conducted to achieve competence in the flight procedures described in sections 3 to 5 of this Annex.

6.2 PC2WE risks and mitigation measures - guidance material

6.2.1 This sub-section provides some, but not limiting, guidance to operators on the risks of operating PC2WE and possible mitigation measures. It is written on the assumption that an operator has achieved base-line compliance with the regulated control measures described above. This is meant as a start point to help operators integrate PC2WE risk assessments into their existing SMS risk register. Detailed risk statements, impacts, initial and residual risk levels should be determined in line with the operator's established risk assessment processes.

Table 5: PC2WE risks & possible mitigation measures

Risks	Mitigation Measures
Pilot excessive focus on PC2WE compliance results in obstacle strike.	• Exposition and training briefs highlight obstacle strikes as the highest risk in helipad environments. • Obstacle avoidance techniques are prioritised above engine failure considerations and techniques, due to the relative risk levels. • The company allows variations from compliance with PC2WE considerations, in order to maintain overall safe operations, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system. • A second pilot or air crew member is available to assist into unknown landing sites, smaller than 34 m diameter, to mitigate the risk of obstacle strikes. • The pilot conducts a pre-departure review of the take-off path, likely obstacles, and determination of required performance to avoid obstacles in addition to PC2WE considerations.
Global fleet reliability reduces below the approved 1:100,000 engine power loss rate.	• Company aircraft have historical engine failure rates of 0.26 per 100,000 hours but the company will apply a conservative rate of 0.3 per 100,000 hours. • Annual report has been obtained from Type Certificate Holder to state compliance with 1:100,000-hour engine failure rate target. • Company SMS tracks global accidents for company aircraft to establish early

Risks	Mitigation Measures
	trends of engine failure rates.
Pilot techniques and / or environment require exposure periods greater than the exposure time limit	• The company can justify a 36-second exposure time limit based on power loss rates. • Use of 97% of HOGE as maximum weight provides sufficient power margin to remain within exposure time limits. • Exceeding 36 seconds exposure is only approved for MT or ESO operations at an MT or ESO Operating Site. • Non-MT / ESO operations are conducted to less complex landing sites than for MT / ESOs. • Pilot simulator and line training in vertical and oblique take-off and landing techniques, including awareness of the time it takes to conduct these at 97% HOGE weight limits. • Pilots are trained not to delay the DPATO any later than necessary, and to nominate a DPBL that is as late as possible in the approach. • Pilot simulator training in accurate assessment of aircraft height / speed energy to allow for a safe fly-away.
Pilot PC2WE performance assessment, procedures or flying techniques are inadequate or not understood.	• Exposition has specific sections explaining PC2WE, what it is, and flying techniques to use. • Exposition describes pilot methods for determining obstacle gradients, and this is practiced in Line Training. • Simulator training and checking is conducted in PC2WE techniques up to 97% of the HOGE weight limit. • Co-pilot or Air Crew Member training in PC2WE requirements is provided so they can provide knowledge and procedural support for the pilot. • Variations from PC2WE are permitted, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system.
Pilot PC2WE performance procedures or flying techniques expose third party persons or things to unacceptable impacts of rotor downwash and outwash.	• Exposition procedures for ensuring the safety of people, animals, buildings and things during helicopter operations through the establishment of downwash/outwash protection safety distances for operations. • Liaison with regular use helicopter landing site and heliport operators regarding strategies for minimising the impacts of rotor downwash/outwash at these locations. For example, downwash/outwash protection zones. • Exposition procedures for crews to have operations specific awareness training on the size and effects of rotor downwash/outwash during PC2WE and other operations. • Initial and recurrent competency and proficiency assessments to ensure flight and other crew member awareness of the effects of rotor downwash/outwash during PC2WE and other operations. • Ground crew personnel trained in rotor downwash/outwash effects and safety procedures. • Exposition procedures to ensure operational crews conduct a pre-flight and in-flight operational risk assessment of potential rotor downwash/outwash effects.

Risks	Mitigation Measures
The pilot training system is incomplete or ineffective.	• Company conversion training includes a specific long brief on helicopter performance and PC2WE operations. • 6-monthly simulator sessions conducted, including training and checking in PC2WE operations up to 97% HOGE weights. • Co-pilots and Air Crew Members also participate in pilot simulator training for PC2WE operations. • Line Training provides opportunities to train pilots in the application of obstacle surveys and PC2WE requirements. • Pre-take-off and pre-landing briefings require mention to the crew of whether ‘exposure’ is present, or not. • Six-monthly training meetings review standardization and effectiveness of the training system.
The required engine / airframe preventative maintenance is not conducted.	• Aircraft maintenance is conducted in accordance with the CASA-approved CASR Part 145 Exposition, and company System of Maintenance. • The company follows the preventative maintenance requirements recommended and / or approved by the OEM. • Engine modifications are not conducted without approval of the engine and airframe Type Certificate holder. • The Company Quality Assurance program assesses compliance with the System of Maintenance through an audit program. • Engine and drive-train heavy maintenance is conducted by a CASA and OEM-approved overhaul facility.
Usage Monitoring System fails to record or operate correctly.	• Company OMEL requires a serviceable UMS for PC2WE operations. • Engine and transmission data are automatically sent to, and monitored by, an external organization with regulatory approval to conduct monitoring and reporting. • UMS is maintained and data assessed as accurate in accordance with the CASA-approved CASR Part 145 Exposition, and Company System of Maintenance.

7 PC2WE operations Bell 412EP rotorcraft

7.1 Purpose of this section

7.1.1 The purpose of this section of this Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a Part 119 exposition, or a Part 138 operations manual for PC2 with exposure (PC2WE) operations in the Bell 412EP. It could also be used as a guide for operators using other Bell 412 variants. Noting that PC2WE operations are not mandatory for Part 138 operations. This will allow an AOC or Aerial Work Certificate holder to satisfy CASA of the PC2WE regulatory requirement if they choose to use and follow this Annex. However, they may also propose alternative means of compliance to the AMC proposed here if they so desire. This alternative means will need to be assessed and found acceptable for the purpose by CASA.

7.1.2 Operators and flight crew members should develop an understanding of the performance class system, as detailed within AC 133-01 Performance Class Operations (AC133-01) and AC 133-02 Performance Class 2 With Exposure Operations (AC133-02), prior to reading this section of the Annex.

7.1.3 In addition to the sections in this Annex on PC2WE, and if applicable to their operations, operators are required to detail the procedures for use during PC1, PC2 (without exposure) and PC3 operations in their exposition or operations manual. Guidance on what is required for these operations is contained within AC 133-01.

7.1.4 To maximise the benefit of PC2WE, by keeping exposure times within limits, rotorcraft operators should encourage heliport operators to keep take-off and approach path obstacle-free gradients as low as possible. Failure to achieve this may mean PC2WE is not a viable option at that heliport.

7.1.5 The following sections 8 to 10 are written as AMC for direct transfer into company expositions or operations manuals for a Bell 412EP operator. However, for simplicity, they are based on application of a limited number of Category A procedures, and they exclude the use of ‘drop-down’ procedures below the level of a helideck. Some operators may need to develop additional or replacement exposition material to cater for the specifics of their operations.

7.1.6 The policy of having no engine failure exposure risk from critical infrastructure is a limitation proposed by the example set out in the AMC of the Annex, however this is not a mandatory requirement for operators. Operators may propose alternative procedures to those suggested in sub-sections 10.6 and 10.7.

7.1.7 In addition to the AMC provided in this Annex, operators should consider providing pilots with simplified tables or an electronic method for determining the required performance data so as to avoid potential error with using RFM charts.

7.1.8 Section 11 provides some guidance on how to develop the risk assessment for PC2WE operations.

7.1.9 In this document, reference is made to the Part 133 MOS; however, such referencing is not considered mandatory for an exposition or operations manual, with an expectation that AC 133 referencing AC133-01 and AC133-02 (as applicable) will be sufficient for pilots.

8 Policy for Bell 412EP PC2WE operations

8.1 Background

8.1.1 For maintenance of appropriate operational capability, the company has a requirement to conduct PC2WE operations.

8.1.2 As part of the CASA approval process for PC2WE operations, the company has also completed an Operational Risk Assessment for PC2WE operations. This can be referenced at (insert company manual reference).

8.1.3 PC2WE can allow greater operational flexibility for operations at higher weights, and to and from heliports with more complex obstacle environments. From runway environments PC2WE offers no weight advantage over PC2 because PC2WE HOGE weight limits being more limiting than CAT A runway requirements.

8.1.4 To maintain PC2WE safety risk at an appropriate level, CASA AC 133-02 provides guidance to operators and pilots on how to risk manage such operations. For a deeper understanding of PC2WE operations, company pilots should become familiar with CASA AC 133-02.

8.1.5 Where Bell 412EP performance figures are used, they are based on an aircraft equipped with PT6T-3DF powerplants and fitted with the BLR Fast Fin (FMS 79.4). They are considered to have no heater or air conditioning systems operative during take-off or landing procedures. Pilots must note that configurations that vary from that described above will require different performance figures to what is mentioned in these sections.

8.1.6 In consideration of achieving simplicity in operations and training for PC2WE, company pilots are limited to the following Flight Manual Supplement Category A procedures from BHT-412-FMS-62.3 & 62.4:

- Part B – For Helipads. (Company policy is to also apply the alternate ground level helipad size and profile requirements of BHT-412-FMS-92.3 & 92.4)
- Part C – For Short Airfields (Runways).

8.1.7 The company Training Manual details the additional flight crew training and checking requirements for the procedures described within this section. Before using PC2WE in line operations company flight crew members must complete and been found competent in accordance with the training and checking manual PC2WE requirements outlined therein.

8.1.8 Although PC1 and PC2 operations should be conducted wherever operationally possible, PC2WE is the minimum standard for the following types of operation (refer regulation 133.335 of the CASR):

- passenger transport operations with MOPSC of 10-19
- passenger transport operations under night VFR or IFR
- Medical Transport operations (compliance with a performance class is not mandatory at a Medical Transport Operating Site (regulation 133.315), provided such operations are conducted in accordance with this exposition). The main utility for PC2WE in Medical Transport operations will be to / from hospital heliports where Category A procedures cannot be flown.

8.2 Bell 412EP relevant characteristics and assumptions

8.2.1 The overall length (D-value) for the Bell 412EP is 17.1 m. This is relevant for the dimensions of the heliport FATO and Safety Area. A heliport of insufficient size to meet PC2 requires PC2WE operations.

8.2.2 The rotor radius (R) for the Bell 412EP is 7 m. This is applicable for defining the area to survey beyond DPATO for take-off path obstacles.

8.2.3 Because PC2WE operations do not mandate the use of Category A procedures, targeted selection of the various Category A procedures and associated performance are used by the company to achieve PC2WE compliance. From these, the following assumptions may be made for the company operating environment, and they are summarised in Table 6 below:

- For any Category A Short Field take-off procedure the worst-case time to TDP is 10 seconds from which a safe flyaway at 40 KIAS is possible using the appropriate 'target torque'.
- "Target torque" is as defined in the AFM supplement 62.3 and 62.4 and is the "available 2½ minute OEI torque of (a) minimum specification engine, assured by satisfactory completion of power assurance check".
- For any Category A Short Field take-off procedure using the appropriate 'target torque', the worst-case rejected take-off distance required is 380 m. Distances less than this will require PC2WE.
- For any RFM Category A Short Field take-off or landing procedure, 550 m is the worst-case OEI take-off or baulked landing distance required. For the CAT A Helipad procedure, it is 300 m. The 550 m or 300 m may either be horizontally direct from the take-off point, or it can be created as a virtual clearway allowing a raised incline plane for the OLS (refer to AC 133-01, sections 6.4 and 6.5).
- The worst-case distance for the acceleration segment to get from 40 KIAS to 70 KIAS is 550 m.
- For any CAT A Short Field landing procedure, 250 m is the worst-case OEI landing distance required.
- For any Short Field landing below the CAT A weight limit, OEI height loss from LDP is 35 ft.
- For any "Helipad" take-off or landing when below the CAT A weight limit, the maximum OEI height loss from TDP or LDP is in the range of 65 ft to 115 ft, but with 115 ft being used as the standard for PC2WE. PC2WE operations are not permitted if the TDP or LDP for the procedure is required to be any higher than 300 ft above the heliport (maximum obstacle height of 300-115-35=150 ft). Refer to Part 133 MOS, section 10.06, for further information.

Table 6: Bell 412EP standard performance figures

Scenario	Standard figure
CAT A Short Field worst-case time to TDP (FMS 62.3 & 62.4, Figure 4C-5)	10 secs
CAT A Short Field worst-case rejected take-off distance required (FMS 62.3 & 62.4, Figure 4C-4)	380 m
CAT A Short Field worst-case take-off or baulked landing distance required. (FMS 62.3 & 62.4, Figure 4C-6)	550 m
CAT A Helipad worst-case take-off or baulked landing distance required.	300 m

Scenario	Standard figure
CAT A Short Field worst-case acceleration segment (FMS 62.3 & 62.4, Figure 4C-8, Sheet 3 of 3)	550 m
CAT A Short Field worst-case landing distance required. (FMS 62.3 & 62.4, Figure 4C-10)	250 m
Height loss from CAT A Short Field LDP. (FMS 62.3 & 62.4, Figure 3C-1)	35 ft
Worst-case height loss from CAT A Helipad TDP / LDP. (FMS 62.3 & 62.4, Figure 4B-5)	115 ft

8.3 Maximum permitted exposure time

AMC for Part 133 MOS, section 10.1.

8.3.1 Current engine reliability data from Bell Helicopters for the Bell 412EP allows approved rotorcraft a maximum permitted exposure time of 36 seconds, based on it meeting or exceeding an engine power loss rate of 0.25:100,000 hours.

8.3.2 Pilots are to ensure that the take-off and landing techniques used for PC2WE require no more than 36 seconds of exposure. If this is not possible, the PIC must take steps to reduce weight and / or adopt alternative techniques such that the maximum exposure time is not exceeded.

8.4 PC2WE limitations & performance charts

AMC for Part 133 MOS, section 10.12.

8.4.1 This sub-section details company operating limitations, and relevant performance charts for PC2WE, including those for determining take-off weight limitations to meet the requirements of section 10.12 of the Part 133 MOS. The company will provide pilots with extracts of the relevant charts (or tabulated / computerised data), as per Table 7 below, for determination of PC2WE performance.

Table 7: RFM performance chart reference

Limitation	Reference chart
97% HOGE Limit	FMS 79.4, Figure 4-4
Power Available at 2.5-min rating	FMS 62.3 & 62.4, Figure 4B-3
2.1% (150 fpm) gradient to 1,000 ft using 30-min power at 70 KIAS	MD-4, Figure 4-9 (Sheet 3 / 8)
7.5% gradient at 40 KIAS using 2.5-min power to remain above a 4.5% Obstacle Limitation Surface (OLS). 8% if over populous areas.	FMS 62.3 & 62.4, Figure 4C-7
50 fpm OEI ROC at 30-minute OEI power and 70 KIAS	MD-4, Figure 4-9 (Sheet 5 / 8)

8.4.2 Category A Weight-Altitude-Temperature limitation charts and 100 fpm OEI charts at VTOSS are not included for discussion in this section as they are more specifically applicable to PC1 and PC2 operations. However, operations within the CAT A helipad weight limits will help to reduce the exposure risk.

8.4.3 PC2WE is more weight limiting than PC2 operations if using Short Field (runway) take-off techniques. This is because a requirement of PC2WE is to ensure the aircraft is capable of AEO hover out of ground effect (HOGE) performance which allows an acceleration from a vertical climb into forward flight. The company does not consider that the Take-Off Power HOGE weight limit provides sufficient power margin to achieve this. To ensure sufficient AEO HOGE performance, pilots must ensure that the maximum aircraft weight for PC2WE operations is not greater than 97% of the AEO HOGE weight limit at Take-Off Power. This weight limit is normally more limiting than the 70 KIAS OEI rates of climb requirements mentioned below but may not be as limiting as the 40 KIAS OEI requirement.

8.4.4 Determining the power available at the 2.5-minute rating (target torque) provides a guide to what AEO power should be aimed for during an approach to ensure maintenance of the approach path in the event of an engine power loss.

For example, at 30° C and 2,000 ft, the target torque is 66%, so the aim should be to keep the AEO mast torque below 66% during the approach until over the helipad.

8.4.5 Pilots must ensure that, for PC2WE operations, the aircraft weight at take-off or landing is no greater than that required to achieve an OEI rate of climb of 150 fpm (equates to 2.1% at 70 KIAS) 1,000 ft above the heliport. In these calculations, wind benefit must not be applied.

For example, for a take-off at the 97% HOGE weight limit of 11,100 lb at 30° C and 2,000 ft, a 70 KIAS OEI climb gives a 5% (350 fpm) climb gradient.

8.4.6 The B412 CAT A procedures have a level acceleration segment to accelerate at 200 ft from 40 KIAS to 70 KIAS. Due to the presence of this segment, for the aircraft to stay more than 35 ft above the OLS before reaching 70 KIAS, the initial 40 KIAS 2.5-min OEI climb gradient must be steeper than the OLS gradient. Calculations show that combining a 7.5% gradient up to 200 ft with the worst-case 550 m level acceleration gives an overall gradient of 4.5%. Pilots must ensure that, if wishing to use a DPATO / DPBL of 40 KIAS below 200 ft, for a standard OLS gradient of 4.5%, they have at least a 7.5% OEI climb gradient at 40 KIAS and 2.5-min power. Alternatively, the Vy of 70 KIAS could be used as the DPATO, if the exposure time permits. This would negate the need for a climb gradient of greater than the OLS gradient.

For example, at 11,100 lb, 30° C and 2,000 ft, the 40 KIAS OEI climb gradient is 6.5%, which is insufficient to keep the aircraft more than 35 ft above the OLS after the acceleration. If a 70 KIAS DPATO was not being applied, weight would need to be reduced to 10,900 lb to achieve the required 7.5%.

Note: Any surveyed OLS gradient of greater than 4.5% would require further calculations to determine a 40 KIAS OEI climb gradient higher than the 7.5% to ensure that the acceleration segment did not impinge on the OLS **(or use 70 KIAS as DPATO)**.

8.4.7 To provide additional OEI power margins and reduce risk over populous areas, pilots must also ensure that, for company PC2WE operations over populous area, the aircraft weight at take-off or landing is no greater than that required to achieve a 40 KIAS 2.5-min OEI climb gradient of 8.0%, at 1,000 ft above the heliport. In these calculations, wind benefit must not be applied.

For example, at 30° C and 2,000 ft, the limiting weight would be 10,900 lb, being marginally more limiting than the 97% HOGE weight limit (refer to AC 133-02, section 2.9.2).

Note: AC 133-02, section 2.9.2, indicates that 8.0% is not mandatory; however, the company has incorporated this into the standard operating procedures as a safety enhancement.

8.4.8 Pilots must ensure that above the lower of DPATO / DPBL or 300 ft, the OEI gradient of climb is greater than or equal to the take-off path OLS gradient. OLS gradients for commonly used heliports are indicated in the company helipad register. Otherwise, they should be calculated as described in sub-section 9.2 below.

8.4.9 As for PC1 and PC2, the OEI rate of climb at the minimum altitude must be at least 50 fpm. The minimum altitude for Day VFR and NVIS flight is 1,000 ft, and for night unaided or IFR flight is LSALT or MSA.

For example, 50 fpm is achievable up to 11,500 lb and 28° C at 6,000 ft, so this should rarely be a limiting factor for company Bell 412EP operations.

8.4.10 When conducting short field or open area operations, pilots must confirm that the available hard, smooth, level, surface suitable for a rejected take-off is greater than the 380 m rejected take-off distance required. If the available distance is less than 380 m, PC2WE is required. However, if operating PC2WE, this also means weights will need to be limited per the HOGE requirements mentioned above.

8.4.11 When operating from elevated heliports and helidecks, the ground level helipad procedure may be used, as modified by FMS-92.3 & 92.4. If built on top of critical infrastructure or occupied buildings, pilots must not, for any take-off, accept an engine failure exposure risk that involves rejecting back to the building, after entry into the avoid area of the HV envelope (16ft). This means a rejected take-off to the heliport or helideck must not be conducted unless within the CAT A helipad weight limits.

8.5 Suitable Forced Landing Area

8.5.1 Exposure can be avoided if usable reject or OEI landing areas can be classified as a suitable forced landing area. The area can be considered suitable if it meets the requirements for a PC2 heliport as discussed in section 9.1 below, and which also equates to the RFM ‘smooth, level and firm surface’, as discussed under the height-velocity limitations section of the basic RFM. Pilots must assess potential suitable forced landing areas by referencing the company heliport register for a known location or on the basis of the guidance in CASA AC 133-01, section 4.1.

8.5.2 Water landing areas, when assessed as suitable by the company SMS, can also be considered as suitable forced landing areas for the Bell 412EP. The aircraft must be fitted with an approved emergency flotation system and operated in not greater than sea state 4 conditions (this is a certification requirement). However, there must also be a reasonable expectation of rescue within survival times, and the operations be in areas where search and rescue capabilities are available. For the purpose of this requirement, the company defines the boundaries of areas where SAR capability is available at (insert company manual reference) of this exposition (refer to regulation 133.010 of the CASR).

8.5.3 Regardless of the quality of the forced landing area, it is not considered suitable for PC2 operations if an attempted OEI landing is made from inside the avoid area of the HV envelope, unless below the applicable CAT A weight limits, or during a normal angle approach. Likewise, for an area to be suitable during a clear or open area rejected take-off, the smooth, level and firm surface available (runway plus possible stopway) must exceed the RFM rejected take-off distance required (refer to Part 133 MOS, subparagraph 38(f)(ii)). In the Bell 412EP, it can be up to 380 m, so pilots must have an awareness of this distance, particularly from very short areas, to be able to determine the need for PC2WE and the consequential reduced weights.

8.6 Height-Velocity limitation

AMC for Part 133 MOS, section 2.02.

8.6.1 PC2WE operations are not required if entry into the avoid area of the HV envelope is part of:

- a take-off, landing, or hover (including winching) operation at a medical transport operating site
- winch operations with OEI HOGE performance, or
- when operating within RFM CAT A limitations and procedures (this would be PC2 at least).

8.6.2 Other than as mentioned above, any operational requirement to enter the avoid area of the HV envelope during take-off will require pilots to ensure PC2WE requirements can be met, even if a suitable forced landing area is available.

8.6.3 For the Bell 412EP, pilots can assume they are outside of the avoid area of the HV envelop if below 16 ft and faster than 40 KIAS.

8.6.4 Operations outside the avoid area of the HV envelope will still require PC2WE operations if a suitable forced landing area is not available, or if a safe OEI flyway is not possible.

8.7 Adequate Vertical Margin

Part 133 MOS, section 10.02 & 10.30.

8.7.1 As part of the PC2WE requirements, prior to DPATO and after DPBL, pilots must fly the aircraft to avoid all obstacles by at least an adequate vertical margin.

8.7.2 The company defines 15 ft (4.5 m) as an adequate vertical margin for the Bell 412EP. However, under the following circumstances pilots must use at least 20 ft (6 m) as an adequate vertical margin:

- when the physical nature of the obstacles makes depth perception difficult
- when visibility is degraded due to precipitation, bright lights, or windshield obscurants
- at the pilot’s discretion.

9 Bell 412EP Survey Procedures

AMC for Part 133 MOS, section 10.32(6).

9.1 Instructions for heliport survey

9.1.1 PC2WE operations could mean exposure to an OEI landing risk on a sub-standard reject area, and / or exposure to a flyaway risk. Pilots are to determine whether the proposed OEI reject area requires PC2WE.

9.1.2 Except in the case of extreme surface conditions such as swamp, marshland or heavily ploughed fields, surface strength of ground level areas never requires PC2WE, provided the size and slope are within the limits mentioned below. PC2WE operations to elevated heliports / helidecks must not be conducted above the stated weight limits for those structures.

9.1.3 PC2WE is required for any rejected take-off or OEI landing area if:

- the diameter of area is less than 34.2 m. This may be measured through use of mapping applications, by pacing the area, or if an airborne assessment may be based on pilot judgement and comparison with known area sizes.
- using a CAT A Clear Area take-off profile where the reject distance available is less than the reject distance required.
- the mean slope of the area is greater than 5°.

9.2 Instructions for obstacle survey

9.2.1 Pilots are permitted to conduct airborne or ground surveys of PC2 and PC2WE take-off and approach paths for determination of relevant obstacles in accordance with this sub-section (refer to Part 133 MOS, subsection 10.32(6)).

9.2.2 Surveys of certified or registered instrument runways are not required, but prior to using these runways, pilots must determine the OLS gradient and Accelerate Stop Distance Available (ASDA) from the ERSA Runway Distance Supplement (ASDA is the same as the rejected take-off distance available and includes the runway length plus stopway).

9.2.3 Due to the complexity of conducting a pilot survey, where possible, pilots are to take advantage of existing heliport obstacle survey information provided in AirServices Australia documentation or in the company heliport register for commonly used heliports. These surveys are normally compliant with a 4.5% OLS gradient from the edge of the FATO to 500 ft, within a 9° (15%) splay left and right of the FATO edge.

9.2.4 Survey information received on the same day from other company pilots may be used provided their use of the heliport was in the last 12 months.

9.2.5 Pilot surveys must only be conducted by day or at night using NVIS.

9.2.6 As discussed in sub-section 8.2.3 above, 550 m is the worst-case take-off or baulked landing distance required for short fields, and is 300 m for helipads, if within the respective weight limits. This means that, following an engine failure, it could take up 550 m before the aircraft commences a climb. For this reason, a virtual clearway should be established extending 550 m from the FATO if above CAT A helipad weight limits, or to 300 m if below the weight limits. From that point an OLS gradient can be established. However, if conducting a helipad take-off profile, and obstacles are present within the first 300 m or 550 m, the virtual clearway must also be raised to the level of those obstacles and create a raised incline plane for the OLS. This ensures that, from a TDP or rotate point, the OEI height loss still remains 35 ft (10.7 m) above the obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)). (Also, refer to CASA AC 133-01, section 6.4.2).

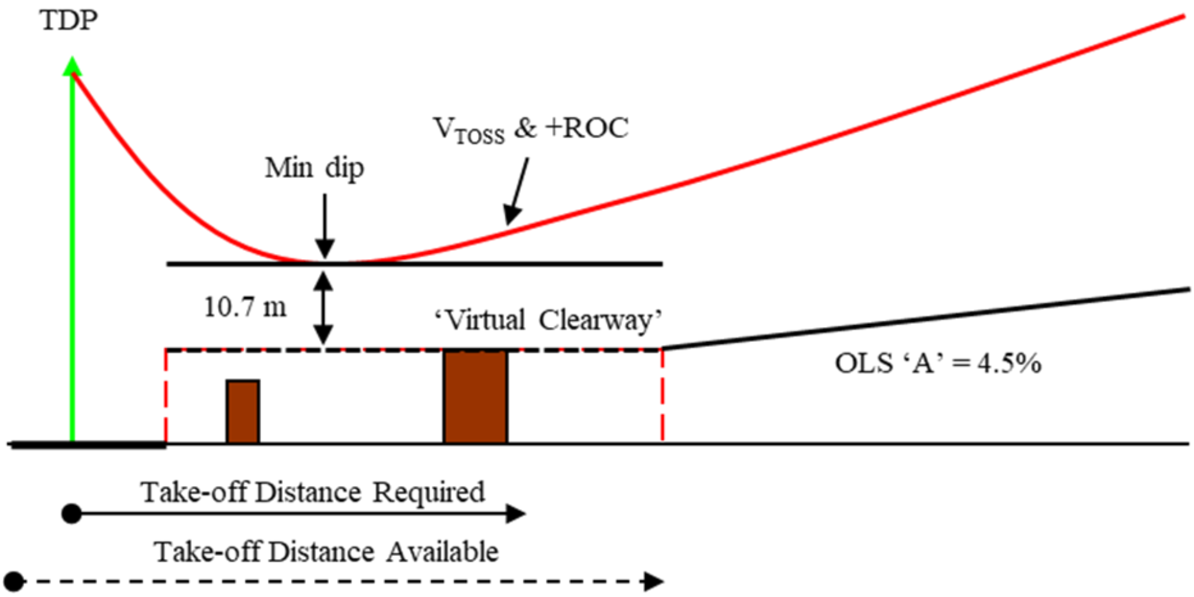

Figure 8: Raised virtual clearway

9.2.7 For company operations, pilots must assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7.5km. Noting that turns are permitted to avoid obstacles once at 200 ft above obstacles by day or on NVIS, or above 500 ft by night unaided, the unavoidable obstacle creating the steepest gradient within this area will be the limiting obstacle. If obstacles at the splay edges are of concern, the splay can be limited to a width of 70 m either side of the take-off path.

9.2.8 Determine the OLS gradient to the limiting obstacle by estimating the height above the raised incline plane, and distance from the end of the virtual clearway. Mapping applications may be used to assist, but pilots may also estimate heights based on obstacle heights of familiar features, such as domestic power poles (10 m).

OLS gradient = 100 x (height of obstacle above raised incline plane) /

(distance to obstacle from end of virtual clearway)

Note: It is acknowledged that the limiting obstacle may not be visible from the helipad due to obstructions in the immediate vicinity. However, it is acceptable for a pilot to use their judgement of heights and distances based on the nature of local vegetation and terrain, and information obtained from mapping applications.

9.2.9 If the calculated OLS gradient exceeds the standard 4.5% (refer to sub-section 8.4.6 above) or the aircraft's OEI climb gradient to 1,000 ft, the pilot must either plan to conduct a turn back to overhead before reaching the critical obstacle or reduce the OLS gradient by further elevating the raised incline plane.

For example, an obstacle 45 m (150 ft) above the raised incline plane, and 500 m from the end of the virtual clearway produces a gradient of 9%. However, if the incline plane is raised by a further 23 m (75 ft), the new calculation would be 100 x 22 / 500 = 4.4%. 4.4% OLS validates the application of a 40 KIAS DPATO with a 7.5% OEI climb gradient. As mentioned earlier, any raising of the incline plane and virtual clearway will also require an upwards correction of the TDP or rotate point for any helipad take-off (refer to Part 133 MOS, subsection 10.12(d)).

9.3 Summary of PC2WE survey requirements

AMC for Part 133 MOS, paragraph 10.28(3)(b).

9.3.1 "Helipad" diameter must be greater than 34.2 m and slope less than 5° to avoid exposure during any rejected take-off or OEI landing.

9.3.2 Assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7.5km.

9.3.3 Identify the highest obstacle in the splay, above or below the helipad, within 300 m if below CAT A helipad weight, or 550 m if above. This equates to the height of the virtual clearway.

Note: Temporary obstacles, such as cranes and other temporary structures, also need to be considered.

9.3.4 Within the splay, assess the height and distance of the limiting obstacle relative to the end of the virtual clearway.

9.3.5 Calculate the OLS gradient to the limiting obstacle from the end of the virtual clearway, and ensure this is less than the aircraft OEI climb gradient to 1,000 ft. If wishing to use a 40 KIAS DPATO, it must be less than 4.5% (refer to Part 133 MOS, sub-section 10.12 (d)).

9.3.6 Adjust the rotate point or TDP to ensure 35 ft clearance from the height of the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)).

9.4 Use of an error budget

9.4.1 Because PC2WE involves various performance calculations, plus pilot visual assessments of dimensions, slopes, heights and distances, all of which are prone to error, it is prudent to ensure there are tolerances for error. The company has the following control measures in place to ensure an appropriate margin of error is available:

- A maximum weight of 97% of HOGE means PC2WE must not be conducted above 11,540 lb.
- PC2WE must not be conducted for approaches to obstructed helipads unless a CAT A helipad approach angle can be flown to a point in space above the helipad (double-angle), and within the CAT A helipad weight limits and procedures.
- For helipad operations, use of a standard 150 ft rotate point allows for a worst-case height loss.
- Wind benefit must not to be considered for PC2WE performance calculations, as this can be unreliable and adds complexity to the gathering of performance data.
- The use of a worst-case 550 m or 300 m take-off distance required is normally in excess of what is actually required.
- The use of an assumed 0.25:100,000-hour engine power loss rate is higher than the reported rate.

10 Flight Procedures

10.1 Take-off and landing common calculations

10.1.1 The following information must be determined prior to all take-offs and landings for the expected weights, altitude and temperature of operations. This may be done on a worst-case basis of weights, altitudes and temperatures to cover multiple take-offs and landings (refer to Part 133 MOS, paragraph 10.28(3)(a)):

- Confirm if the aircraft weight and / or obstacle environment allow the use of CAT A Ground Level Helipad techniques to meet PC2.
- Determine the 97% HOGE weight limit (maximum 11,540 lb). Because this weight is always under the CAT A Short Field weight limit, Short Field performance data can be validly applied (refer to Part 133 MOS, paragraphs 10.12(a) & (b)).
- For the take-off and baulked landing flight paths, determine the OEI climb gradient at 70 KIAS, 30-min power and 1,000 ft (refer to Part 133 MOS paragraph 10.12(c), subparagraph 10.12 (3)(f)(i) and subparagraphs 10.28(3)(c)(ii) & (vi)).
- For the take-off and baulked landing flight paths, determine if the OEI climb gradient at 40 KIAS and 2.5-min power is greater than 7.5% for a standard 4.5% OLS. If so, this allows the use of 40 KIAS as the basis for DPATO and DPBL.
- If over populous areas, confirm the OEI climb gradient at 40 KIAS and 2.5-min power is at least 8.0%.
- Conduct the take-off path survey as per sub-section 9.3 above. If turns are not planned until after the critical obstacle, ensure the OLS gradient is less than the 70 KIAS OEI climb gradient.
- Identify visually, and / or with maps, the optimal flight path to follow if OEI after DPATO or before DPBL, turns are allowed once above 200 ft (500 ft if night unaided) (refer to Part 133 MOS, subparagraphs 10.28 (3)(c)(i) & (v)).
- Determine OEI rate of climb at 70 KIAS and 30-min power, at 1,000 ft AGL for Day VFR or NVIS, otherwise at LSALT, is at least 50 fpm (refer to Part 133 MOS, paragraph 10.12(e); subparagraph 10.28(3)(c)(iv)).

10.2 Take-off from open areas unsuitable for a rejected take-off

10.2.1 This procedure could be used from treeless paddocks or open fields that are unsuitable for a rejected take-off. This sub-section assumes the immediate lift-off area is of a suitable size and slope for a forced landing.

10.2.2 Despite having the option of conducting this open area procedure, pilots should use the helipad procedures described later in this section if they assess the relative risk and the consequence of a rejected take-off will be lessened, even if this means a slightly higher exposure time.

10.2.3 Conduct the take-off using the CAT A Short Field (Runway) procedure. If the virtual clearway is raised, conduct the initial take-off vertically, using up to take-off power, until 35 ft above the virtual clearway height (to a maximum of 150 ft above the heliport), then rotate to accelerate horizontally. Exposure commences from entry into any avoid area of the HV envelope (16 ft) and finishes at the DPATO of 40 KIAS (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

Note: The 150 ft maximum allows 26-secs to reach 150 ft, then 10-secs to accelerate to DPATO.

10.2.4 If OEI after the DPATO, continue with the CAT A Short Field OEI procedure and, if necessary, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles by at least 50 ft and climb to a safe height. Pilots should maintain an awareness of the loss of climb performance during turns.

10.2.5 If OEI before the DPATO, conduct the rejected take-off procedure to land in the safest area available with minimum speed for the surface conditions.

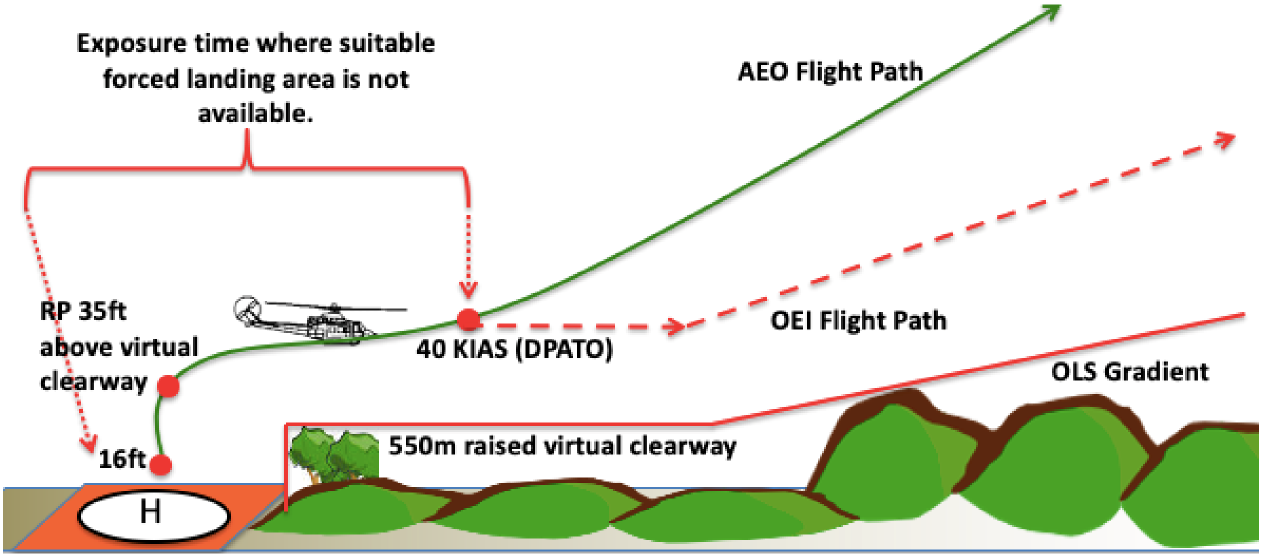

Figure 9: PC2WE open area take-off

10.3 Approach to open areas unsuitable for a run-on landing

10.3.1 This sub-section assumes that obstacles on the approach will allow the CAT A Short Field profile to be safely flown. If not, apply the procedures for a helipad as discussed later in this section.

10.3.2 If a direct approach is possible, no exposure should be present under the PC2WE regime to a suitable helipad. With the required HOGE power margins, and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. For the short field profile, pilots should use an airspeed of 40 KIAS and a height of at least 70 ft above the virtual clearway (as dictated by the landing site), as the basis for when they are ‘committed’ to an OEI landing and can no longer achieve a safe baulked landing (Figure 10 below).

Notes:

1. 70 ft is used as the committal height, instead of 50 ft, to ensure 35 ft obstacle clearance is assured for any baulked landing (RFM assumes 15 ft obstacle clearance).
2. The assumption is that the approach will allow AEO power required to remain below the 2.5-min target torque and so always allow the helipad to be reached.

10.3.3 If OEI before the committal point (DPBL), conduct the CAT A Short Field baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

10.3.4 If OEI after the committal point, continue the approach to land at the helipad with minimum speed for the surface conditions.

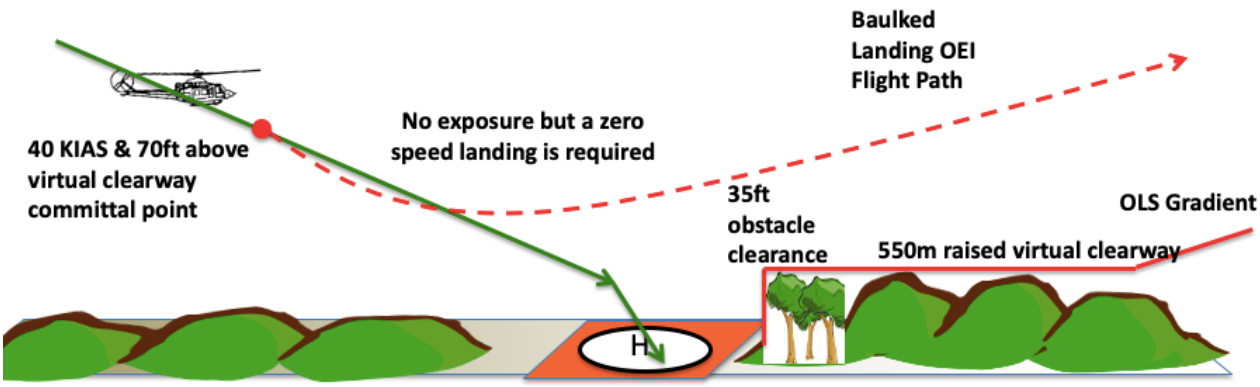

Figure 10: PC2WE open area approach

10.4 PC2WE take-offs from heliports / helidecks

10.4.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

10.4.2 These heliports / helidecks are assumed not to be on top of critical infrastructure but provide a surrounding visual cuing environment sufficient for pilot references to be maintained during extended vertical take-offs.

10.4.3 Confirm the helipad allows for the CAT A helipad back-up procedure to be conducted. This means that, to retain an appropriate obstacle clearance for a reject, there must be no obstacles within a 10° splay higher than a 14° slope, from 15 m rear of the take-off point, back to 120 m (BHT-412-MD-4, Figures 4-13). If obstacles are present and do not allow this procedure, the vertical procedures described later in this sub-section must be applied instead.

Note: The maximum back-up distance of 120 m is based on using the maximum rotate point of 300 ft.

10.4.4 Conduct the take-off using the CAT A Helipad procedure. If the virtual clearway was raised, the Rotate Point (RP) and DPATO must be achievable by 300 ft above the helipad, and:

- If below CAT A weights: TDP at 150 ft above the virtual clearway, there will be no exposure (PC2).
- If below CAT A weights but unable to back-up (Figure 11): Conduct a vertical take-off using up to take-off power and rotate at 150 ft above the virtual clearway. Exposure will be from 16 ft until the RP. Maximum permitted virtual clearway height is 150 ft (300 ft RP).
- If above CAT A weights (Figure 12): Conduct a vertical or back-up take-off using up to take-off power and from 35 ft above the virtual clearway rotate for a level acceleration. Exposure will be from 16 ft until 40 KIAS (DPATO). Maximum permitted virtual clearway height is 115 ft (150 ft RP) (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

10.4.5 In some circumstances, when above CAT A weights (Figure 12 below), the consequence of a rejected take-off after the RP could create a higher risk than continuing a vertical profile. If so, the pilot could fly the back-up profile until at least 200 ft above the helipad, after which a 40 KIAS OEI climb should be achievable (DPATO at RP). However, in these cases, elevation of the virtual clearway cannot be accepted due to the excessive exposure time required to conduct the back-up climb to 200 ft above the obstacles.

10.4.6 If OEI after the DPATO, accelerate to 70 KIAS and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

10.4.7 If OEI before the DPATO, reject the take-off to land back at the helipad, or reject the take-off to land in the safest area available with minimum speed for the surface conditions.

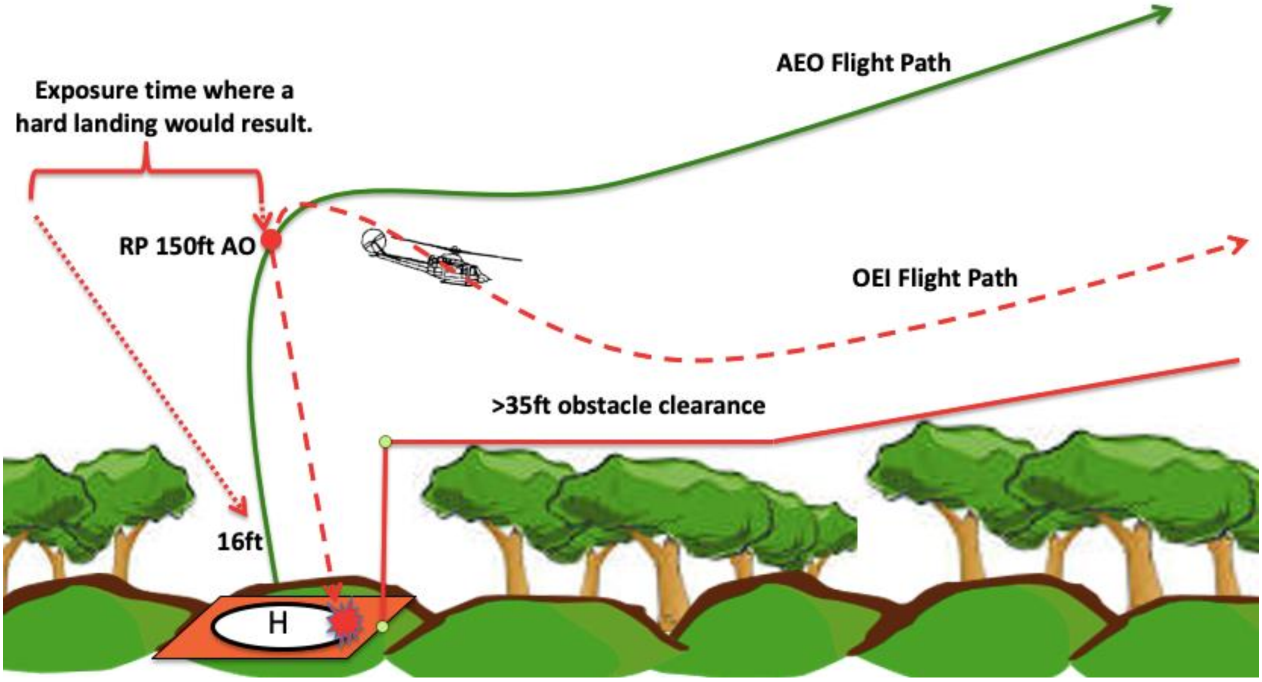

Figure 11: PC2WE Vertical take-off <CAT A

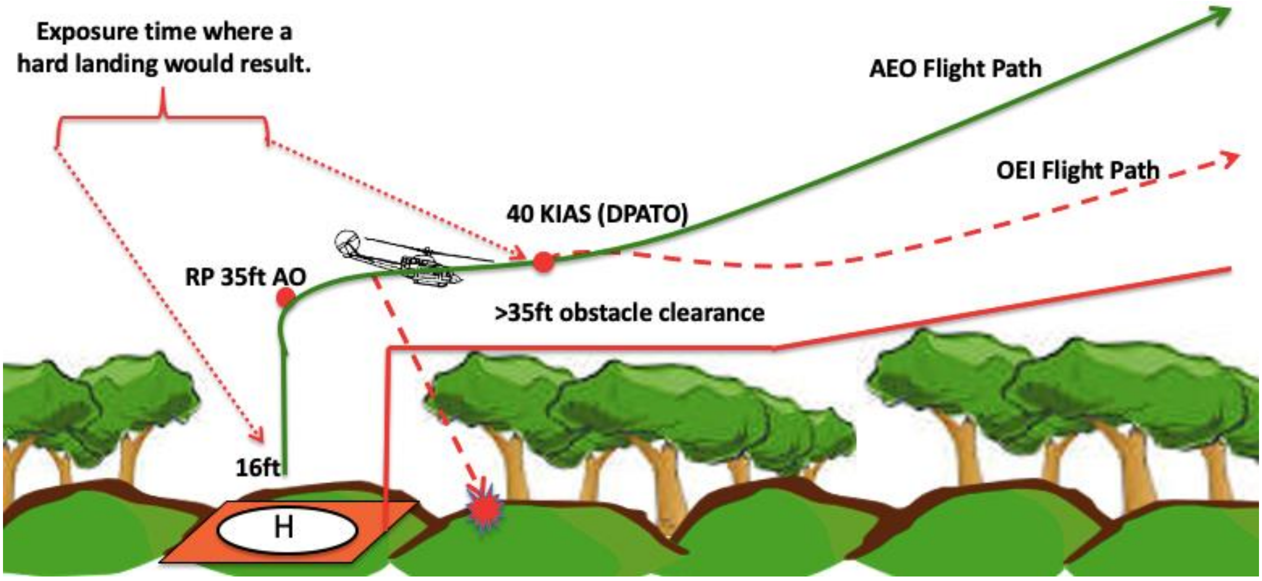

Figure 12: PC2WE Vertical take-off >CAT A

10.5 PC2WE approaches to heliports / helidecks

10.5.1 This sub-section can apply to heliports where obstacles allow a direct approach to a ground level or elevated heliport / helideck, or where the obstacles do not allow the CAT A Helipad approach profile. The difference is that, if obstacles are present, the approach will become a double-angle approach.

10.5.2 If a direct helipad approach is possible and within the CAT A helipad weight limits, PC2WE is not required as this would be PC2.

10.5.3 If a direct helipad approach is possible, but above the CAT A Helipad weight limit, no exposure should be present under the PC2WE regime. With the required HOGE power margins and provided a normal CAT A Helipad approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown on a suitable area. However, pilots should use an airspeed of 40 KIAS and a height at least 70 ft above the virtual clearway (as is dictated by the landing site), as the basis for when they are 'committed' to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the helipad approach will allow AEO power required to remain below the 2.5-min target torque and so always allow the helipad to be reached.

10.5.4 If a direct approach is not possible and a double-angle approach is required, **weights above the CAT A Helipad weight limit are not permitted**. A double-angle procedure could not be conducted safely within the exposure time limits if above these weights.

Note: Pilots **conducting medical transport operations** should be aware this **prohibition does not apply** at a Medical Transport Operating site.

10.5.5 If a double-angle approach is required and within the CAT A weight limits, fly the CAT A helipad approach procedure to a double-angle. Exposure commences at 10 kts groundspeed and 150 ft above any virtual clearway, and it finishes at the helipad (Figure 13 below). However, double-angle approaches are not ideal for PC2WE operations due to the potential for excessive exposure times. For this reason, pilots must not conduct this approach if obstacles in the baulked landing flight path are higher than 30 ft (based on a 300 fpm rate of descent from a 180 ft DPBL).

10.5.6 If OEI before the DPBL, conduct the CAT A Helipad baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

10.5.7 If OEI after the DPBL, the profile should allow continuation of the double-angle approach for a descent into the helipad to land with minimum speed for the surface conditions.

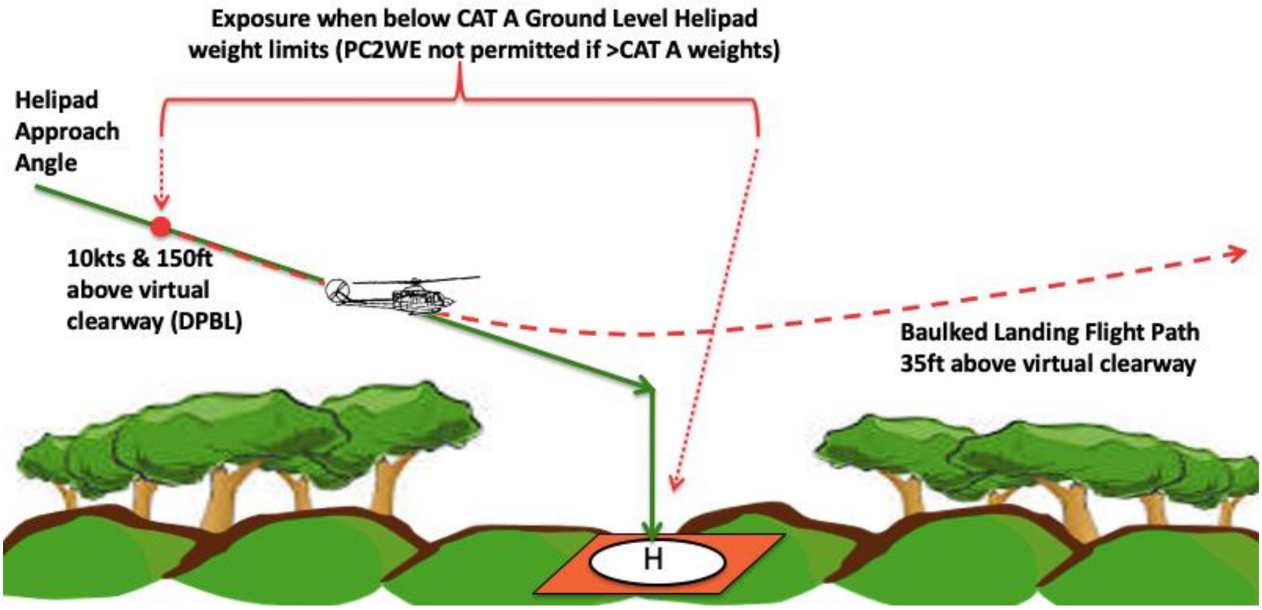

Figure 13: PC2WE obstructed helipad approach

10.6 PC2WE take-offs from elevated heliports / helidecks on critical infrastructure

10.6.1 This sub-section gives an option of lowering or raising the virtual clearway if supported by the pilot survey of a 300 m or 550 m virtual clearway.

10.6.2 **If applying CAT A Helipad weights & procedures**: There is no exposure (PC2) if using a RP 150 ft above the virtual clearway.

10.6.3 **If above CAT A weights**: This is the most critical PC2WE situation for elevated heliports on top of critical infrastructure in populous areas, where a reject back to the heliport may not be an acceptable risk (Figure 14 below):

- Review areas in the take-off path as possible emergency landing areas.
- To minimise risk of a deck-edge strike, commence the take-off from a point with the rotor disc at the front edge of the helideck.
- Apply power up to take-off power and rotate for take-off at 25 ft. DPATO will be when the pilot judges 40 KIAS and a positive climb 35 ft clear of obstacles can be achieved OEI. The exposure risk is from 16 ft until DPATO. Pilot judgement of DPATO will be based on their awareness of aircraft height loss performance, acceleration rates and height above obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

10.6.4 If OEI after the DPATO, accelerate initially to 40 KIAS to commence a climb and, once at 200 ft (or 500 ft by night unaided), accelerate to 70 KIAS, then turn to avoid obstacles as necessary and climb to a safe height.

10.6.5 If OEI before the DPATO, and prior to rotate, reject the take-off to land back at the helipad. If OEI before DPATO, but after the 25 ft RP, attempt to land with minimum speed at the pre-identified emergency landing areas ahead.

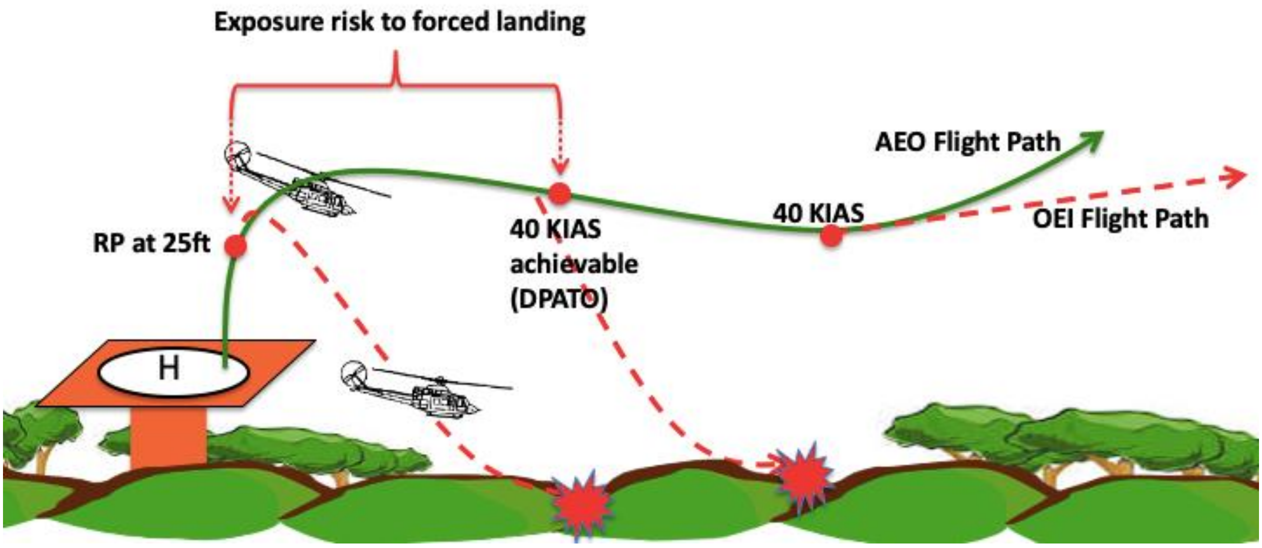

Figure 14: PC2WE Helideck take-off >CAT A

10.7 PC2WE approaches to elevated heliports and helidecks on critical infrastructure

10.7.1 Approaches to elevated heliports and helidecks on critical infrastructure must not be conducted unless a direct helipad approach angle, without a double angle, is possible. This removes the risk of a near vertical descent and engine power loss leading to an excessively heavy landing.

10.7.2 If conducting a direct helipad approach, and within the CAT A Helipad weight limits, PC2WE is not required, as this would be PC2.

10.7.3 If conducting a direct approach, but above the CAT A Helipad weight limit, no exposure should be present under the PC2WE regime for the approach. With the required HOGE power margins and provided a normal ground level helipad approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. However, pilots must use 40 KIAS and 70 ft above the virtual clearway as the basis for when they are committed to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the heliport approach will allow AEO power required to remain below the 2.5-min target torque and so always allow the helipad to be reached.

10.8 Summary of PC2WE DPATO & DPBL

10.8.1 Table 8 below summarises the numbers discussed in sub-sections 10.2 to 10.7 above. In this table, Above Obstacles (AO) is taken to mean height above the established height of the virtual clearway. The common use of 16 ft refers to the base of the avoid area of the HV envelope (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(iii) & (vii)).

Table 8: PC2WE summary of exposure

Open Areas <CAT A	Exposure starts	Exposure finishes
Take-Off	16 ft	40 KIAS (DPATO)

Open Areas <CAT A	Exposure starts	Exposure finishes
Landing	Committed at 40 KIAS & 70 ft AO but no exposure on a normal profile	
Ground Level or Elevated Helipad		
Vertical Take-off <CAT A	16 ft	150 ft AO (DPATO)
Vertical Take-off >CAT A	16 ft	40 KIAS + 35 ft AO (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 70 ft AO but no exposure on a normal profile	
Landing double-angle <CAT A	10kts G / S & 150 ft AO (DPBL)	at helipad
Landing double-angle >CAT A	Not permitted	
Elevated Helipad (on critical infrastructure)		
Take-off >CAT A	16 ft	40 KIAS achievable (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 70 ft AO but no exposure on a normal profile	

11 PC2WE Risk Assessments

11.1 Risk mitigation by CASA

11.1.1 CASA reviews the acceptability of an operator's PC2WE operations on the basis of compliance with the requirements of the Part 133 MOS, sections 10.11 to 10.16. These are summarised as:

- a maximum exposure time of 36 seconds, with anything above nine seconds supportable by engine power loss rates proportionally less than 1:100,000 hours
- having in excess of HOGE power margins
- all rotorcraft and engine preventative maintenance actions are completed
- risk assessment procedures for Bell 412EP PC2WE operations are in place, including measures to mitigate the risk (refer to sub-section 11.2 below)
- operations are conducted in accordance with the RFM and this exposition
- flight crew training and checking is conducted to achieve competence in the flight procedures described in sections 8 to 10 of this Annex.

11.2 PC2WE risks and mitigation measures

11.2.1 This sub-section provides some, but not limiting, guidance to operators on the risks of operating PC2WE and possible mitigation measures. It is written on the assumption that an operator has achieved base-line compliance with the regulated control measures described above. This is meant as a start point to help operators integrate PC2WE risk assessments into their existing SMS risk register. Detailed risk statements, impacts, initial and residual risk levels should be determined in line with the operator's established risk assessment processes.

Table 9: PC2WE risks & possible mitigation measures

Risks	Mitigation measures
Pilot excessive focus on PC2WE compliance results in obstacle strike.	• Exposition and training briefs highlight obstacle strikes as the highest risk in helipad environments. • Obstacle avoidance techniques are prioritised above engine failure considerations and techniques, due to the relative risk levels. • The company allows variations from compliance with PC2WE considerations, in order to maintain overall safe operations, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system. • A second pilot or air crew member is available to assist into unknown landing sites, smaller than 34 m diameter, to mitigate the risk of obstacle strikes. • The pilot conducts a pre-departure review of the take-off path, likely obstacles, and determination of required performance to avoid obstacles in addition to PC2WE considerations.
Global fleet reliability reduces below the approved 1:100,000 engine power loss rate	• Company aircraft have historical engine failure rates of 0.05 per 100,000 hours but the company will apply a conservative rate of 0.25 per 100,000 hours. • Annual report has been obtained from Type Certificate Holder to state compliance with 1:100,000-hour engine failure rate target. • Company SMS tracks global accidents for company aircraft to establish early trends of engine failure rates.

Risks	Mitigation measures
Pilot techniques and / or environment require exposure periods greater than the exposure time limit	• The company can justify a 36-second exposure time limit based on power loss rates. • Use of 97% of HOGE as maximum weight provides sufficient power margin to remain within exposure time limits. • Exceeding 36 seconds exposure is only approved for MT or ESO operations at an MT or ESO Operating Site. • Non-MT / ESO operations are conducted to less complex landing sites than for MT / ESOs. • Pilot simulator (if available) and line training in vertical and oblique take-off and landing techniques, including awareness of the time it takes to conduct these at 97% HOGE weight limits. • Pilots are trained not to delay the DPATO any later than necessary, and to nominate a DPBL that is as late as possible in the approach. • Pilot simulator (if available) training in accurate assessment of aircraft height / speed energy to allow for a safe fly-away.
Pilot PC2WE performance assessment, procedures or flying techniques are inadequate or not understood	• Exposition has specific sections explaining PC2WE, what it is, and flying techniques to use. • Exposition describes pilot methods for determining obstacle gradients, and this is practiced in Line Training. • Simulator training and checking (if available) is conducted in PC2WE techniques up to 97% of the HOGE weight limit. • Co-pilot or Air Crew Member training in PC2WE requirements is provided so they can provide knowledge and procedural support for the pilot. • Variations from PC2WE are permitted, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system.
Pilot PC2WE performance procedures or flying techniques expose third party persons or things to unacceptable impacts of rotor downwash and outwash.	• Exposition procedures for ensuring the safety of people, animals, buildings and things during helicopter operations through the establishment of downwash/outwash protection safety distances for operations. • Liaison with regular use helicopter landing site and heliport operators regarding strategies for minimising the impacts of rotor downwash/outwash at these locations. For example, downwash/outwash protection zones. • Exposition procedures for crews to have operations specific awareness training on the size and effects of rotor downwash/outwash during PC2WE and other operations. • Initial and recurrent competency and proficiency assessments to ensure flight and other crew member awareness of the effects of rotor downwash/outwash during PC2WE and other operations. • Ground crew personnel trained in rotor downwash/outwash effects and safety procedures. • Exposition procedures to ensure operational crews conduct a pre-flight and in-flight operational risk assessment of potential rotor downwash/outwash effects.

Risks	Mitigation measures
The pilot training system is incomplete or ineffective	• Company conversion training includes a specific long brief on helicopter performance and PC2WE operations. • Six-monthly simulator (if available) sessions conducted, including training and checking in PC2WE operations up to 97% HOGE weights. • Co-pilots and Air Crew Members also participate in pilot simulator (if available) training for PC2WE operations. • Line Training provides opportunities to train pilots in the application of obstacle surveys and PC2WE requirements. • Pre-take-off and pre-landing briefings require mention to the crew of whether 'exposure' is present, or not. • Six-monthly training meetings review standardization and effectiveness of the training system.
The required engine / airframe preventative maintenance is not conducted	• Aircraft maintenance is conducted in accordance with the CASA-approved CASR Part 145 Exposition, and company System of Maintenance. • The company follows the preventative maintenance requirements recommended and / or approved by the OEM. • Engine modifications are not conducted without approval of the engine and airframe Type Certificate holder. • The Company Quality Assurance program assesses compliance with the System of Maintenance through an audit program. • Engine and drive-train heavy maintenance is conducted by a CASA and OEM-approved overhaul facility.
Usage Monitoring System fails to record or operate correctly	• Company OMEL requires a serviceable UMS for PC2WE operations. • Engine and transmission data are automatically sent to, and monitored by, an external organization with regulatory approval to conduct monitoring and reporting. • UMS is maintained and data assessed as accurate in accordance with the CASA-approved CASR Part 145 Exposition, and Company System of Maintenance.

12 PC2WE operations BK117 B2 and BK117 C2

12.1 Purpose of this section

12.1.1 The purpose of this section of the Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a CASR Part 119 exposition or a CASR Part 138 operations manual for PC2 with exposure (PC2WE) operations in either the MBB or Kawasaki versions of the BK117 B-2. It also provides information and guidance material for the BK117 B-2 fitted with the LTS101-850B-2 powerplants and the BK117 C-2 (EC-145). Noting that PC2WE operations are not mandatory for Part 138 operations, this will allow an AOC or Aerial Work Certificate holder to satisfy CASA of the PC2WE regulatory requirement if they choose to use and follow this Annex. However, they may also propose alternative means of compliance to the AMC proposed here if they so desire. This alternative means will need to be assessed and found acceptable for the purpose by CASA.

12.1.2 Operators and flight crew members should develop an understanding of the performance class system, as detailed within AC 133-01 Performance Class Operations (AC133-01) and AC 133-02 Performance Class 2 With Exposure Operations (AC133-02), prior to reading this section of the Annex.

12.1.3 In addition to the sub-sections in this Annex on PC2WE and if applicable to their operations, operators are required to detail the procedures for use during PC1, PC2 (without exposure), and PC3 operations in their exposition or operations manual. Guidance on what is required for these operations is contained within AC 133-01.

12.1.4 To maximise the benefit of PC2WE by keeping exposure times within limits, operators should encourage heliport operators to keep take-off and approach path obstacle-free gradients as low as possible. Failure to achieve this may mean PC2WE is not a viable option at that heliport. This is particularly important for the BK117 B-2, which at this time has a more limited exposure time allowance than the EC-145.

12.1.5 The following sections 13 to 15 are written as AMC for direct transfer into company expositions or operations manuals for a Kawasaki BK117 B-2 operator. With minor editing, they may also be applied to MBB BK117 B-2 operators.

12.1.6 The policy of having no engine failure exposure risk from critical infrastructure is a limitation proposed by the example set out in the AMC of the Annex, however this is not a mandatory requirement for operators. Operators may propose alternative procedures to those suggested in sub-sections 15.6 and 15.7.

12.1.7 In addition to the AMC provided in this Annex, operators should consider providing pilots with simplified tables or an electronic method for determining the required performance data so as to avoid potential error with using RFM charts

12.1.8 In the AMC, variations in performance data with the BK117 variant powered by LTS101-850B-2 powerplants and the EC-145 are explained in the 'Notes'. Operators should utilise the relevant data for the rotorcraft used in their operations.

12.1.9 Section 16 provides some guidance on how to develop the risk assessment for PC2WE operations.

12.1.10 In this document, reference is made to the Part 133 MOS; however, such referencing is not considered mandatory for an exposition or operations manual, with an expectation that referencing AC133-01 and AC133-02 (as applicable) will be sufficient for pilots.

13 Policy for BK117 PC2WE operations

13.1 Background

13.1.1 For maintenance of appropriate operational capability, the company has a requirement to conduct PC2WE operations.

13.1.2 Company approval to conduct PC2WE operations is predicated upon achieving CASA requirements for:

- a target level of safety
- engine reliability assessment
- continuing engine reliability assurance
- mitigating airworthiness procedures, and
- mitigating operational procedures and training (refer to AC 133-02, section 3).

13.1.3 As part of the CASA approval process for PC2WE operations, the company has also completed an Operational Risk Assessment for PC2WE operations. This can be referenced at (insert company manual reference).

13.1.4 PC2WE can allow greater operational flexibility for operations at higher weights, to and from heliports with more complex obstacle environments.

13.1.5 To maintain PC2WE safety risk at an appropriate level, CASA AC 133-02 provides guidance to operators and pilots on how to risk manage such operations. For a deeper understanding of PC2WE operations, company pilots should become familiar with CASA AC 133-02.

13.1.6 BK117 performance figures used are based on a Kawasaki aircraft equipped with LTS101-750B-1 powerplants, post S / N 1117 and with KSB-117-125 incorporated. It is assumed to be fitted without any external optional equipment (which gives performance penalties) and to have no heater or environmental control systems operative during take-off or landing procedures. Pilots must note that configurations that vary from that described above will require different performance figures to what is mentioned in these sections.

Notes:

1. If operating the MBB version of the BK117 B-2 post S / N 7253 or after S / B-MBB-BK117-60-113, the same performance data as mentioned herein for the KHI BK117 B-2 applies. Otherwise, configurations that vary from that described above will require different performance figures to what is mentioned in this Annex. For example, fitment of a hoist degrades the OEI climb gradients by 2.0%.
2. Where EC-145 performance figures are used, they are based on an aircraft fitted with Arriel 1E2 powerplants; do not confuse these with the EC-145 T2 variant fitted with Arriel 2E powerplants.

13.1.7 Performance data is drawn from the basic Kawasaki RFM as well as the following Flight Manual Supplement Category A procedures:

- Supplement 11-1 for Category A Operations (Clear Heliport)
- Supplement 11-5 for Category A Operations (VTOL).

Note: Performance data for the LTS101-850 and EC-145 variants is also taken from their respective Clear Heliport and VTOL RFM Supplements, 13.1.8 The company Training Manual details the additional training and checking requirements for the procedures described within this section. Before using PC2WE in line operations company flight crew members must complete and been found competent in accordance with the training and checking manual PC2WE requirements outlined therein.

13.1.9 Although PC1 and PC2 operations should be conducted wherever operationally possible, PC2WE is the minimum standard for the following types of BK117 operation (refer regulation 133.335 of the CASR):

- passenger transport operations under night VFR or IFR
- medical transport operations (noting compliance with a performance class is not mandatory at a Medical Transport Operating Site (regulation 133.315), provided such operations are conducted in accordance with this exposition). The main utility for PC2WE in Medical Transport operations will be to / from hospital heliports where Category A limits and procedures cannot be applied.

13.2 BK117 relevant characteristics and assumptions

13.2.1 The overall length (D-value) for the BK117 is 13 m. This is relevant for the dimensions of the heliport FATO and Safety Area. A heliport with defined areas of insufficient size and capability to meet PC2 requires PC2WE operations.

13.2.2 The rotor radius (R) for the BK117 is 5.5 m. This is applicable for defining the area to survey beyond DPATO for take-off path obstacles.

13.2.3 Because PC2WE operations do not mandate the use of Category A procedures, targeted selection of the different Category A procedures and associated performance are used by the company to achieve PC2WE compliance. From these, the following assumptions may be made for the company operating environment, and they are summarised in Table 10 below:

- For any Category A Clear Heliport take-off procedure, the worst-case rejected take-off distance required is 470 m. Available distances less than this will require PC2WE.

Note: For the LTS101-850 variant, it is also 470 m. For the EC-145, it is 330 m.

- For any RFM Category A Clear Heliport or VTOL take-off or landing procedure, 270 m is the worst-case OEI take-off or baulked landing distance required. The 270 m may either be available horizontally directly from the take-off point, or it can be created as a virtual clearway allowing a raised incline plane for the OLS (refer to AC 133-01, sections 6.4 and 6.5).

Note: For the LTS 101-850 variant, it is 270 m for the Clear Heliport, but 220 m for the VTOL. For the EC-145, it is 380 m.

- For any CAT A Clear Heliport landing procedure, 220 m is the worst-case OEI landing distance required.
- For any Clear Heliport or VTOL landing below the respective CAT A weight limits, OEI height loss from LDP is 65 ft.
- For any VTOL take-off when below the CAT A weight limit, the OEI height loss from TDP is 105 ft. PC2WE operations are not permitted if the TDP or LDP for the procedure is any higher than 300 ft above the heliport (maximum obstacle height of 160 ft). Refer to Part 133 MOS, section 10.06, for further information.

Note: For the EC-145 OEI, height loss from TDP is 85 ft.

Table 10: BK117 standard performance figures

Scenario	Standard figure
CAT A Clear Heliport worst case rejected take-off distance required (RFM Supp 11-1, Figure 5-2)	470 m
CAT A Clear Heliport or VTOL worst case take-off or baulked landing distance required. (RFM Supp 11-1, Figure 5-2A)	270 m
CAT A Clear Heliport worst case landing distance required. (RFM Supp 11-1, Figure 5-5)	220 m
Height loss from CAT A Clear Heliport or VTOL LDP	65 ft
Height loss from CAT A VTOL TDP	105 ft

13.3 Maximum permitted exposure time

AMC for Part 133 MOS, section 10.11.

13.3.1 Current engine reliability data from Airbus Helicopters allows approved BK117B2 rotorcraft a maximum permitted exposure time of 20 seconds, based on the aircraft meeting or exceeding an engine power loss rate of 0.45:100,000 hours.

Notes:

1. Operators are to ensure they receive an annual report from the OEM, confirming this figure remains accurate; otherwise, the exposure time limit may need to be amended.
2. For the LTS 101-850 variant, the maximum permitted exposure time is also 20 seconds.

13.3.2 Current engine reliability data from Airbus Helicopters for the EC-145 allows approved rotorcraft a maximum permitted exposure time of 36 seconds, based on it meeting or exceeding an engine power loss rate of 0.25:100,000 hours.

13.3.3 Pilots are to ensure that the take-off and landing techniques used for PC2WE require no more than 20 seconds of exposure for the BK117B2. If this is not possible, the PIC must take steps to reduce weight and / or adopt alternative techniques such that the maximum exposure time is not exceeded.

13.3.4 Pilots must ensure the take-off and landing techniques used for PC2WE require no more than 36 seconds for the EC-145.

13.4 PC2WE limitations & performance charts

AMC for Part 133 MOS, section 10.12.

13.4.1 This sub-section details company operating limitations and relevant performance charts for PC2WE, including those for determining take-off weight limitations to meet the requirements of section 10.12 of the Part 133 MOS. The company will provide pilots with extracts of the relevant charts (or tabulated / computerised data), as per Table 11 below, for determination of PC2WE performance.

Table 11: RFM performance chart reference

Limitation	Reference chart
CAT A Clear Heliport Maximum Take-Off & Landing Gross Weight	RFM Supp 11-1, Figure 5-1
97% HOGE Limit	Basic RFM, Figure 5-8
2.3% (150 fpm) gradient to 1,000 ft using 30-min power at 65 KIAS	RFM Supp 11-1, Figures 5-4 & 5-4A
If over populous areas – 8.0% Gradient to 1,000 ft at 50 KIAS	RFM Supp 11-1, Figures 5-3 & 5-3A
50 fpm OEI ROC at 30-minute OEI power and 65 KIAS	Basic RFM, Figure 5-27

13.4.2 The Category A VTOL maximum take-off and landing gross weight chart is not included for discussion in this section, as it is more specifically applicable to PC1 and PC2 operations. However, operations within the CAT A VTOL weight limits will help to reduce the exposure risk.

Notes:

1. For the LTS101-850 variant, higher VTOL weight limits can allow PC2 operations at higher weights and payloads than the PC2WE weight limits mentioned below for the standard BK117B2. This provides a great reduction in OEI risk.
2. The EC-145 offers less additional payload for VTOL PC2 operations due to the higher basic weight.

13.4.3 There is a requirement of PC2WE to ensure there is sufficient HOGE performance to conduct a departure and approach from / to a hover OGE. The company achieves this by limiting PC2WE maximum gross weights to the lesser of the CAT A Clear Heliport weight limit, or the 97% of the AEO HOGE weight limit. These weight limits are more limiting than the 150 fpm OEI rates of climb requirements mentioned below.

Notes:

1. For the LTS101-850 variant, 97% of the AEO HOGE weight limit is the limiting weight for PC2WE. At 3,000 ft and 30° C, this can provide an additional 240 kg of payload over the standard BK117B2.
2. For the EC-145, 97% of the AEO HOGE weight limit is also the limiting weight for PC2WE. At 3,000 ft and 30° C, this can provide an approximate additional 400 kg of payload over the standard BK117B2.

13.4.4 Pilots must ensure that, for PC2WE operations, the aircraft weight at take-off or landing is no greater than that required to achieve an OEI rate of climb of 150 fpm (equates to 2.3% at 65 KIAS) 1,000 ft above the heliport. In these calculations, wind benefit must not be applied.

For example, for a take-off at the CAT A Clear Heliport weight limit of 3,100 kg at 30° C & 1,000 ft; a 65 KIAS OEI climb gives 3% (195 fpm).

Notes:

1. For the LTS101-850 variant at the 97% HOGE weight limit, 4% OEI climb gradient is achieved with 150 kg higher payload. For the EC-145 at the 97% HOGE weight limit, 3.5% OEI climb gradient is achieved with a 210 kg higher payload.
2. For the EC-145 at the 97% HOGE weight limit, 3.5% OEI climb gradient is achieved with a 210 kg higher payload.

13.4.5 To take advantage of a reduced exposure time, pilots may also determine whether the 150 fpm OEI rate of climb requirement is also achievable at 50 KIAS and 2.5-min power. If so, this allows 50 KIAS to be used as the onset of exposure for an approach, or the completion of exposure for a take-off.

As in the previous example, at 3,100 kg, 30° C and 1,000 ft, a 50 KIAS OEI climb at 2.5-min power should give a 300 fpm (6.0%) rate of climb.

Notes:

1. For the LTS101-850 variant at the 97% HOGE weight limit, 350 fpm OEI rate of climb is achieved with 150 kg higher payload. For the EC-145 at the 97% HOGE weight limit, 315 fpm OEI rate of climb is achieved with a 210 kg higher payload.
2. For the EC-145 at the 97% HOGE weight limit, 315 fpm OEI rate of climb is achieved with a 210 kg higher payload.

13.4.6 To provide additional OEI power margins and reduce risk over populous areas, pilots must also ensure that, for PC2WE operations, the aircraft weight at take-off or landing is no greater than that required to achieve a 50 KIAS OEI rate of climb at 2.5-min power of 8.0%, at 1,000 ft above the heliport. In these calculations, wind benefit must not be applied.

For example, at 30° C and 1,000 ft, the limiting weight will be 2,920 kg, instead of the 3,100 kg indicated by the CAT A Clear Area weight limit, or the 3,250 kg indicated by 97% HOGE (refer to AC 133-02, section 2.9.2).

Note: AC 133-02, section 2.9.2, indicates that 8.0% is not mandatory; however, the company has incorporated this into the standard operating procedures as a safety enhancement.

13.4.7 Pilots must ensure that above the lower of DPATO / DPBL or 300 ft, the OEI gradient of climb is greater than or equal to the take-off path obstacle-free gradient (also known as the Obstacle Limiting Surface (OLS) gradient). OLS gradients for commonly used heliports are indicated in the company helipad register. Otherwise, they should be calculated as described in sub-section 14.3 below.

Note: Because the EC-145 requires an OEI acceleration distance component to accelerate from 45 KIAS VTOSS to 65 KIAS VY, if the DPATO / DPBL is based on VTOSS, the combination of the VTOSS climb and the acceleration distance must also remain 35 ft above the OLS. This adds complexity to the calculation of the OEI flight path against the OLS clearance requirements. Approximately 7.7% OEI climb gradient is required at 45 KIAS for the combined VTOSS climb and acceleration distance to remain above a 4.5% OLS gradient.

13.4.8 As for PC1 and PC2, the OEI rate of climb at the minimum altitude must be at least 50 fpm. The minimum altitude for Day VFR and NVIS flight is 1,000 ft, and for night unaided or IFR flight, it is LSALT or MSA.

For example, 50 fpm is achievable up to 3,100 kg at 20° C and 5,000 ft.

13.4.9 If wishing to conduct PC2 operations from a clear heliport or open area, pilots must confirm that the available smooth, firm, level, surface suitable for a rejected take-off is greater than the worst-case 470 m rejected take-off distance required. If the available distance is less than 470 m, PC2WE is required.

Note: For the EC-145, this distance is 330 m.

13.4.10 When operating from elevated heliports and helidecks, the VTOL procedure may be used. If built on top of critical infrastructure or occupied buildings, pilots must not, for any take-off, accept an engine failure exposure risk that involves rejecting back to the building after entry into the avoid area of the HV envelope (12ft). This means a rejected take-off to the heliport or helideck must not be conducted unless within the CAT A VTOL weight limits.

Note: For the LTS101-850 variant, this would allow operations with payloads up to 300 kg higher than that of the standard BK117B2. However, for the EC-145, there is minimal payload advantage because the improved VTOL weight limit is negated by the heavier aircraft basic weight.

13.5 Suitable Forced Landing Area

13.5.1 Exposure can be avoided if usable reject or OEI landing areas can be classified as a suitable forced landing area. An area can be considered suitable if it meets the requirements for a PC2 heliport as discussed in sub-section 14.1 below, and which also equates to the RFM ‘smooth, firm and level surface’, as discussed under the height-velocity section of the RFM. Pilots must assess potential suitable forced landing areas by referencing the company heliport register for a known location, or on the basis of the guidance in AC 133-01, section 4.1.

13.5.2 Water landing areas, when assessed as suitable by the company SMS, can also be considered as suitable forced landing areas for the BK117. The aircraft must be fitted with an approved emergency flotation system and operated in not greater than sea state 4 conditions. However, there must also be a reasonable expectation of rescue within survival times, and that operations are conducted in areas where search and rescue capabilities are available. For the purpose of this requirement, the company defines the boundaries of areas where SAR capability is available at (insert company manual reference) of this exposition.

13.5.3 Regardless of the quality of the forced landing area, it is not considered suitable for PC2 operations if an attempted OEI landing is made from inside the avoid area of the HV envelope unless below the applicable CAT A VTOL weight limits, or during a normal angle approach. Likewise, for an area to be suitable during a clear or open area rejected take-off, the smooth, level and firm surface available (runway plus possible stopway) must exceed the RFM rejected take-off distance required (refer to Part 133 MOS, subparagraph 38(f)(ii)). In the BK117, it can be up to 470 m, so pilots must have an awareness of this distance, particularly from very short areas, so they can determine the need for PC2WE and the consequential reduced weights.

13.6 Height-Velocity limitations

AMC for Part 133 MOS, section 2.02.

13.6.1 PC2WE operations are not required if entry into the avoid area is part of:

- a take-off, landing, or hover (including winching) operation at a medical transport operating site
- winch operations with OEI HOGE performance, or
- when operating within RFM CAT A limitations and procedures (this would be PC2 at least).

13.6.2 Other than as mentioned above, any operational requirement to enter the avoid area of the height-velocity envelope during take-off will require pilots to ensure PC2WE requirements can be met, even if a suitable forced landing area is available.

13.6.3 For the BK117 operating at the weight limits associated with PC2WE, pilots can assume they are outside of the avoid area if below 12 ft and faster than 25 KIAS.

Note: For the EC-145 at the 97% HOGE weight limits, 38 KIAS is required to be clear of the avoid area of the HV envelope.

13.6.4 Operations outside the avoid area will still require PC2WE operations if a suitable forced landing area is not available, or if a safe OEI flyway is not possible.

13.7 Adequate Vertical Margin

Part 133 MOS, sections 10.02 & 10.30.

13.7.1 As part of the PC2WE requirements, prior to DPATO and after DPBL, pilots must fly the aircraft to avoid all obstacles by at least an adequate vertical margin.

13.7.2 The company defines 10 ft (3.0 m) as an adequate vertical margin for the BK117. However, under the following circumstances, pilots must use at least 15 ft (4.5 m) as an adequate vertical margin:

- when the physical nature of the obstacles makes depth perception difficult
- when visibility is degraded due to precipitation, bright lights, or windshield obscurants
- at the pilot’s discretion.

14 BK117 Survey Procedures

(AMC for Part 133 MOS, section 10.32(6))

14.1 Instructions for heliport survey

14.1.1 PC2WE operations could mean exposure to an OEI landing risk on a sub-standard reject area, and / or exposure to a flyaway risk. Pilots are to determine whether the proposed OEI reject area requires PC2WE.

14.1.2 Except in the case of extreme surface conditions, such as swamp, marshland or heavily ploughed fields, surface strength of ground level areas never requires PC2WE, provided the size and slope are within the limits mentioned below. PC2WE operations to elevated heliports / helidecks must not be conducted above the stated weight limits for those structures.

14.1.3 PC2WE is required for any rejected take-off or OEI landing area if:

- the diameter of area is less than 26 m. This may be measured through use of mapping applications, by pacing the area, or if an airborne assessment may be based on pilot judgement and comparison with known area sizes.
- using a CAT A Clear Heliport take-off profile, the reject distance available is less than the reject distance required (refer to sub-section 13.5.3 above)
- the mean slope of the area is greater than 5°.

14.2 Instructions for obstacle survey

14.2.1 Pilots are permitted to conduct airborne or ground surveys of PC2 and PC2WE take-off and approach paths for determination of relevant obstacles in accordance with this sub-section (refer to Part 133 MOS, subsection 10.32(6)).

14.2.2 Surveys of certified or registered instrument runways are not required, but prior to using these runways, pilots must access the OLS gradient and Accelerate Stop Distance Available (ASDA) from the ERSA Runway Distance Supplement (ASDA is the same as the rejected take-off distance available and includes the runway length plus stopway).

14.2.3 Due to the complexity of conducting a pilot survey, where possible, pilots are to take advantage of existing heliport obstacle survey information provided in AirServices Australia documentation, or in the company heliport register for commonly used heliports. These surveys are normally compliant with a 4.5% OLS gradient from the edge of the FATO to 500 ft, within a 9° (15%) splay left and right of the FATO edge.

14.2.4 Survey information received on the same day from other company pilots may be used, provided their use of the heliport was in the last 12 months.

14.2.5 Pilot surveys must only be conducted by day or at night using NVIS.

14.2.6 As discussed in section 13.2.3 above, 270 m is the worst-case take-off and baulked landing distance required when within the CAT A Clear Heliport weight limits. This means that following an engine failure, it could take up 270 m before the aircraft commences a climb. For this reason, a virtual clearway should be established, extending 270 m from the FATO. From that point, an OLS gradient can be established. However, if conducting a helipad take-off profile and obstacles are present within the first 270 m, the virtual clearway must also be raised to the level of those obstacles this creates a raised incline plane for the OLS. This ensures that, from a TDP or rotate point, the OEI height loss still remains 35 ft (10.7 m) above the obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)). Also, refer to CASA AC 133-01.

Note: In the EC-145, the 380 m virtual clearway should be extended by the 550 m acceleration distance to ensure the VY climb is achieved by the end of the virtual clearway – in many cases this is likely to be impractical. One alternative is to conduct calculations to ensure the combination of a steep VTOSS climb and the acceleration distance do not impinge upon being 35 ft clear of the OLS. The simplest is to use 65 KIAS as the basis for DPATO, but this increases exposure times by a few extra seconds.

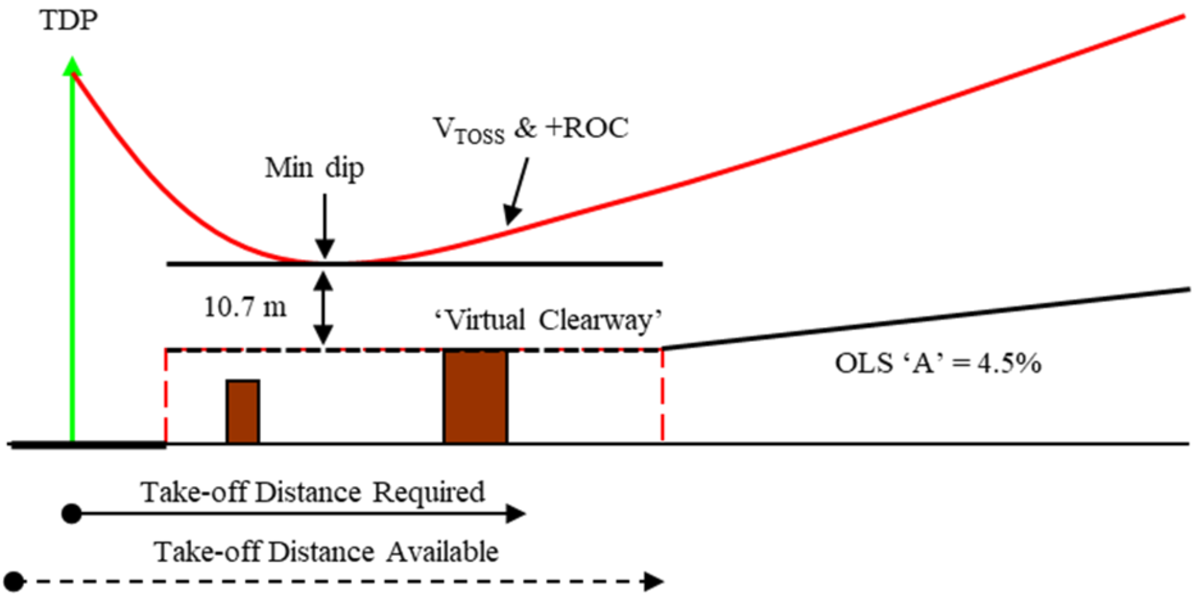

Figure 15: Raised virtual clearway

14.2.7 For company operations, pilots must assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7.0 km. Noting that turns are permitted to avoid obstacles once at 200 ft above obstacles by day or on NVIS, or above 500 ft by night unaided, the unavoidable obstacle creating the steepest gradient within this area will be the limiting obstacle. If obstacles at the splay edges are of concern, the splay can be limited to a width of 55 m either side of the take-off path.

14.2.8 Determine the OLS gradient to the limiting obstacle by estimating the height above the raised incline plane, and distance from the end of the virtual clearway. Mapping applications may be used to assist, but pilots may also estimate heights based on obstacle heights of familiar features such as domestic power poles (10 m).

OLS gradient = 100 x (height of obstacle above raised incline plane) /

(distance to obstacle from end of virtual clearway)

Note: It is acknowledged that the limiting obstacle may not be visible from the helipad due to obstructions in the immediate vicinity. However, it is acceptable for a pilot to use their judgement of heights and distances based on the nature of local vegetation and terrain, and information obtained from mapping applications.

14.2.9 If the calculated OLS gradient exceeds the aircraft's OEI climb gradient to 1,000 ft, the pilot must either plan to conduct a turn back to overhead before reaching the critical obstacle or reduce the OLS gradient by further elevating the raised incline plane. For example, an obstacle 60 m (200 ft) above the raised incline plane, and 500 m from the end of the virtual clearway, produces a gradient of 12%. However, if the incline plane is raised by a further 30 m (100 ft), the new calculation would be 100 x 30 / 500 = 6%, which may be achievable by the aircraft. As mentioned earlier, any raising of the incline plane and virtual clearway will also require an upwards correction of the TDP or rotate point for any helipad take-off (refer to Part 133 MOS, paragraph 10.12(d))

14.3 Summary of PC2WE survey requirements

AMC for Part 133 MOS, paragraph 10.28(3)(b).

14.3.1 Helipad diameter must be greater than 26 m and slope less than 5° if wishing to avoid exposure during any rejected take-off or OEI landing.

14.3.2 Assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7 km.

14.3.3 Identify the highest obstacle in the splay, above or below the helipad, within 270 m. This equates to the height of the virtual clearway.

Note: Temporary obstacles, such as cranes and other temporary structures, also need to be considered.

14.3.4 Within the splay, assess the height and distance of the limiting obstacle relative to the end of the virtual clearway.

14.3.5 Calculate the OLS gradient to the limiting obstacle from the end of the virtual clearway and ensure this is less than the aircraft OEI climb gradient to 1,000 ft (refer to Part 133 MOS, paragraph 10.12(d)).

14.3.6 Adjust the rotate point or TDP to ensure 35 ft clearance from the height of the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)).

14.4 Use of an error budget

14.4.1 Because PC2WE involves various performance calculations, plus pilot visual assessments of dimensions, slopes, heights and distances, all of which are prone to error, it is prudent to ensure there are tolerances for error. The company has the following control measures in place to ensure an appropriate margin of error is available:

- A maximum weight of 97% of HOGE means PC2WE must not be conducted above 3,250 kg.

Note: A maximum weight of 97% of HOGE means PC2WE must not be conducted above 3,470 kg for the EC-145.

- PC2WE must not be conducted for approaches to obstructed heliports unless a CAT A VTOL approach angle can be flown to a point in space above the heliport (double-angle) and able to operate within the CAT A VTOL weight limits and procedures.

Note: For the LTS101-850 variant, this can allow payloads up to 300 kg higher than that of the standard BK117B2.

- Wind benefit must not to be considered for PC2WE performance calculations as this can be unreliable and adds complexity to the gathering of performance data.

- The use of a worst-case 270 m take-off distance is normally in excess of what is usually required.
- The use of an assumed 0.45:100,000-hour engine power loss rate is higher than the reported rate.

Note: For the EC 145 the use of an assumed 0.25:100,000-hour engine power loss rate is higher than the reported rate.

15 Flight Procedures

15.1 Take-off and landing common calculations

15.1.1 The following information must be determined prior to all take-offs and landings for the expected weights, altitude and temperature of operations. This may be done on a worst-case basis of weights, altitudes and temperatures to cover multiple take-offs and landings (refer to Part 133 MOS, paragraph 10.28(3)(a)):

- Confirm whether the aircraft weight and / or obstacle environment allows the use of CAT A VTOL techniques to meet PC2.

> **Note:** For the LTS101-850 variant, this will be a more achievable scenario.

- Determine the limiting weight of the CAT A Clear Heliport or 97% HOGE weight limits (maximum 3,250 kg). Usually, this will be the CAT A Clear Heliport weight limit (refer to Part 133 MOS, sub-sections 10.12(a) & (b)).

> **Note:** The limiting weight for the LTS101-850 variant and the EC-145 is generally the 97% HOGE weight limit, to a maximum of 3,250 kg and 3,477 kg, respectively.

- For the take-off and baulked landing flight paths, determine the OEI climb gradient at 65 KIAS, 30-min power and 1,000 ft (refer to Part 133 MOS, paragraph 10.12(c), subparagraph 10.12(f)(i) and subparagraphs 10.28(3)(c)(ii) & (vi)).
- For the take-off and baulked landing flight paths, determine whether the OEI climb gradient at 50 KIAS and 2.5-min power is greater than 150 fpm. If so, this may help limit the exposure time.
- If over populous areas, confirm the OEI climb gradient at 50 KIAS and 2.5-min power is at least 8.0%.
- Conduct the take-off path survey as per sub-section 14.3 above. If turns are not planned until after the critical obstacle, ensure the OLS gradient is less than the 65 KIAS OEI climb gradient.
- Identify visually, and / or with maps, the optimal flight path to follow if OEI after DPATO or before DPBL, but only allow for turns once above 200 ft (500 ft if night unaided) (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(i) & (v)).

> **Note:** The EC-145 has a stated OEI climb gradient penalty during turns of 1.0%, with 15-degree angle of bank at 65 KIAS.

- Determine OEI rate of climb at 65 KIAS and 30-min power, at 1,000 ft AGL for Day VFR or NVIS, otherwise at LSALT, is at least 50 fpm (refer to Part 133 MOS, paragraph 38(e) and subparagraph 10.28(3)(c)(iv)).

15.2 Take-off from open areas unsuitable for a rejected take-off

15.2.1 This procedure could be used from treeless paddocks or open fields that are unsuitable for a rejected take-off. This sub-section assumes the immediate lift-off area is of a suitable size and slope for a forced landing.

15.2.2 Despite having the option of conducting this open area procedure, pilots should alternatively use the helipad procedures described later in this section if they assess the relative risk and the consequences of a rejected take-off will be lessened (even if this means a slightly higher exposure time).

15.2.3 Conduct the take-off using the CAT A Clear Heliport procedure. If the virtual clearway is raised, conduct the initial take-off vertically using up to take-off power until 35 ft above the virtual clearway height (to a maximum of 75 ft above the heliport); then, rotate to fly the Clear Heliport procedure. Exposure commences from entry into any avoid area of the HV envelope (12 ft) and finishes at 40 KIAS (DPATO) (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

Notes:

1. The 75 ft maximum allows 14-secs to reach 75 ft then 6-secs to accelerate to 40 KIAS.
2. Due to the 36-secs exposure time permitted for the EC-145, the virtual clearway can be raised by a maximum of 115 ft for maximum rotate point of 150 ft.

15.2.4 If OEI after the DPATO, continue with the CAT A Clear Heliport OEI procedure and, if necessary, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles by at least 50 ft and climb to a safe height. Pilots should maintain an awareness of the loss of climb performance during turns.

15.2.5 If OEI before the DPATO, conduct the rejected take-off procedure to land in the safest area available with minimum speed for the surface conditions.

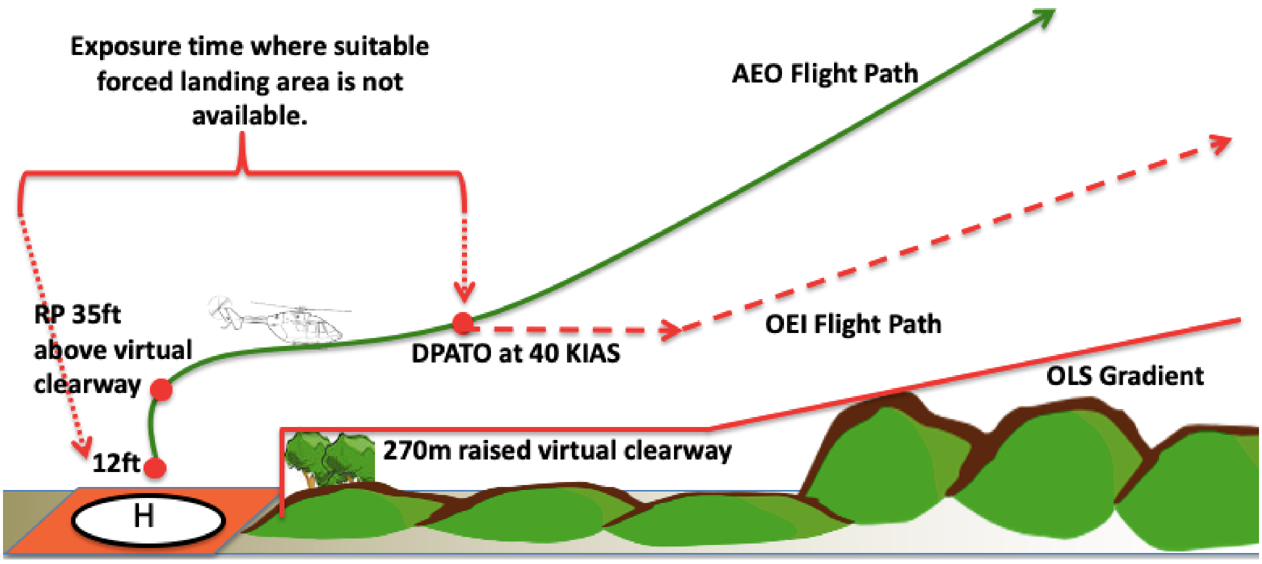

Figure 16: PC2WE open area take-off

15.3 Approach to open areas unsuitable for a run-on landing

15.3.1 This sub-section assumes that obstacles on the approach will allow the CAT A Clear Heliport profile to be flown. If not, apply the procedures for a helipad as discussed later in this section.

15.3.2 If a direct approach is possible, no exposure should be present under the PC2WE regime to a suitable helipad. With the required HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. For the clear area profile, pilots should use an airspeed of 40 KIAS and a height of at least 100 ft above the virtual clearway (as dictated by the landing site), as the basis for when they are 'committed' to an OEI landing and can no longer achieve a safe baulked landing (Figure 17 below).

Note: The assumption is that the approach will allow AEO power required to remain below 62% TQ (equivalent to 124% OEI TQ) and, therefore, always allow the helipad to be reached.

15.3.3 If OEI before the committal point (DPBL), conduct the CAT A Clear Heliport baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary, then climb to a safe height.

15.3.4 If OEI after the committal point, continue the approach to land at the helipad with minimum speed for the surface conditions.

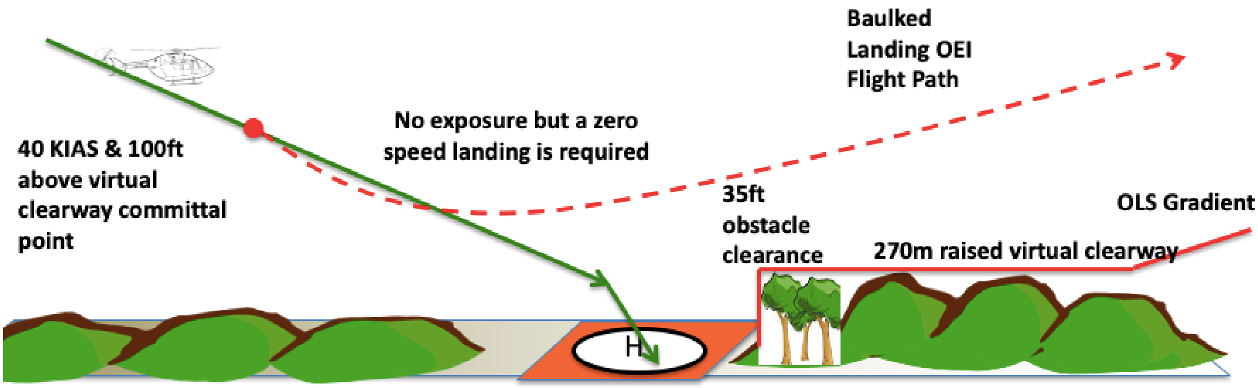

Figure 17: PC2WE open area approach

15.4 PC2WE take-offs from heliports / helidecks

15.4.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

15.4.2 These helipads are assumed not to be on top of critical infrastructure but provide a surrounding visual cuing environment sufficient for pilot references to be maintained during extended vertical take-offs.

15.4.3 Confirm the helipad allows for the CAT A VTOL back-up procedure to be conducted. This means that, to retain an appropriate obstacle clearance for a reject, there must be no obstacles within a 10° splay higher than a 30° slope, from 20 m rear of the take-off point back to 170 m. If obstacles are present and do not allow this procedure, the vertical procedures described later in this sub-section must be applied instead.

> **Note:** The maximum back-up distance of 170 m is based on using the maximum TDP or rotate point of 300 ft.

15.4.4 Conduct the take-off using the CAT A VTOL procedure. If the virtual clearway was raised, the Rotate Point (RP) and DPATO must be achievable by 300 ft above the helipad, and:

- If below CAT A weights: TDP at 140 ft above the virtual clearway there is no exposure (PC2).
- If below CAT A weights but unable to back-up (Figure 18): Conduct a vertical take-off using take-off power and rotate at 140 ft above the virtual clearway. Exposure will be from 12 ft until the RP. Maximum permitted virtual clearway height is 30 ft (170 ft RP).

> **Notes:**
>
> 1. Assumes a 500 fpm AEO vertical rate of climb for 20-secs.
> 2. Due to the longer exposure time limit, the EC-145 could accept a maximum virtual clearway height of 180 ft for a 300 ft rotate point.

- If above CAT A weights (Figure 19): Conduct a vertical or back-up take-off using take-off power and from 35 ft above the virtual clearway rotate to accelerate horizontally. Exposure will be from 12 ft until 40 KIAS (DPATO). Maximum permitted virtual clearway height is 40 ft (75 ft RP) (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

> **Operator Note:**
>
> Due to the longer exposure time limit, the EC-145 could accept a maximum virtual clearway height of 115 ft for a 150 ft rotate point.

15.4.5 In some circumstances when above CAT A weights (Figure 19 below), the consequence of a rejected take-off after the RP could create a higher risk than continuing a vertical profile. However, because there is no data on OEI height loss at such weights, pilots must accept the exposure risk of OEI after the RP as shown in Figure 19 below.

15.4.6 If OEI after the DPATO, accelerate to 65 KIAS and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary, then climb to a safe height.

15.4.7 If OEI before the DPATO, reject the take-off to land back at the helipad, or reject the take-off to land in the safest area available with minimum speed for the surface conditions.

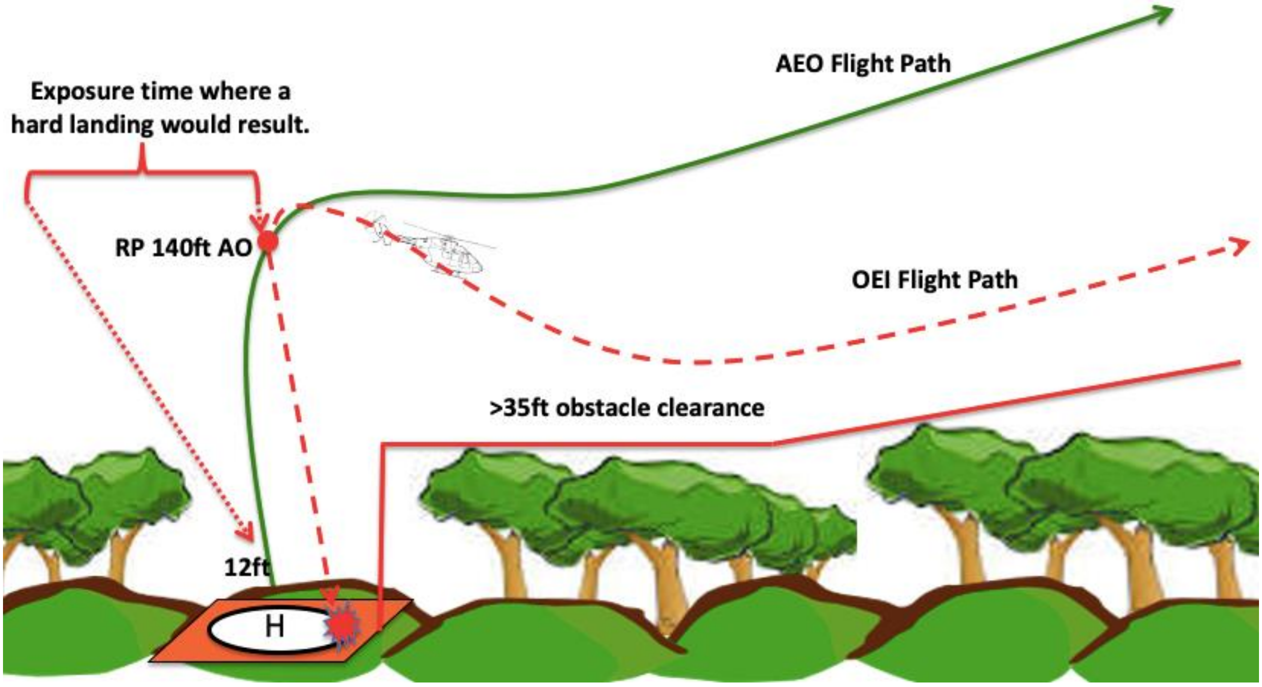

Figure 18: PC2WE Vertical take-off <CAT A

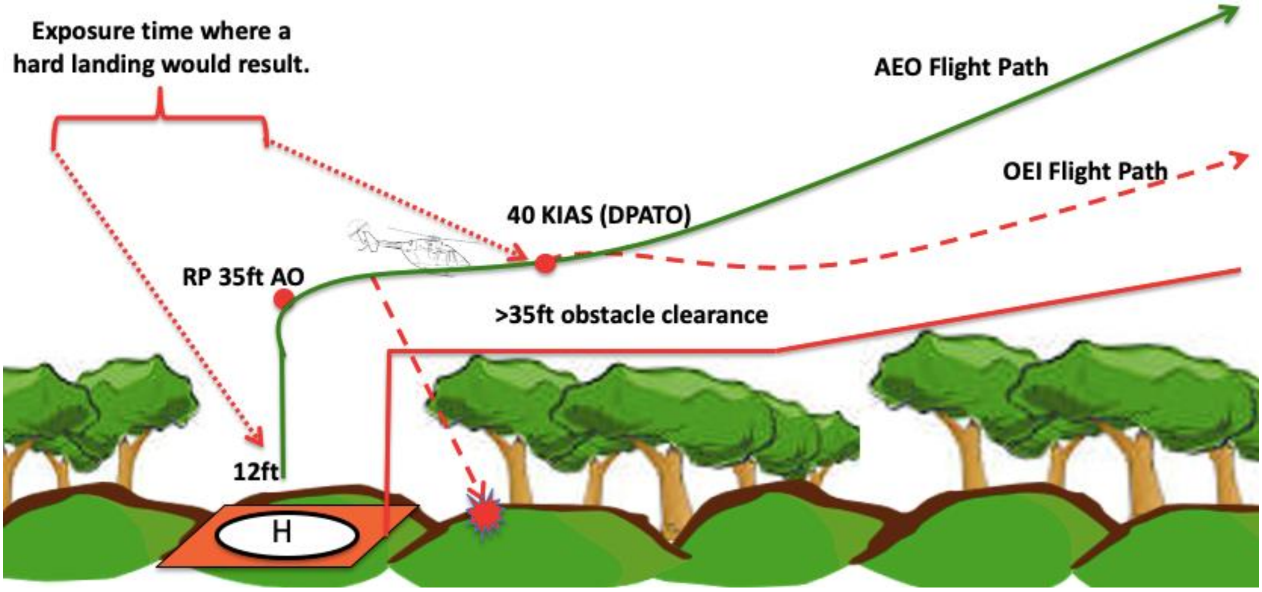

Figure 19: PC2WE Vertical take-off >CAT A

15.5 PC2WE approaches to heliports / helidecks

15.5.1 This sub-section can apply to heliports where obstacles allow a direct CAT A VTOL approach to a ground level or elevated heliport / helideck, or where the obstacles do not allow the approach profile. The difference is that, if obstacles are present, the approach will become a double-angle approach.

15.5.2 If a direct helipad approach is possible, and within the CAT A VTOL weight limits, PC2WE is not required as this would be PC2.

15.5.3 If a direct helipad approach is possible, but above the CAT A VTOL weight limit, no exposure should be present under the PC2WE regime. With the required HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the HV envelope to touchdown on a suitable area. However, pilots should use an airspeed of 40 KIAS and a height of at least 100 ft above the virtual clearway (as dictated by the landing site), as the basis for when they are ‘committed’ to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the normal approach angle will allow AEO power required to remain below 62% TQ and, therefore, always allow the helipad to be reached.

15.5.4 If a direct approach is not possible and a double-angle approach is required, weights above the CAT A VTOL weight limit are not permitted. A double-angle procedure could not be conducted safely within the exposure time limits if above these weights.

Note: For pilots conducting medical transport operations this prohibition does not apply at an MTO site.

15.5.5 If a double-angle approach is required and within the CAT A VTOL weight limits, fly the CAT A VTOL approach procedure to a double-angle. Based on a 300 fpm rate of descent, exposure commences at 20 KIAS and 100 ft and finishes at the helipad (Figure 20 below). However, double-angle approaches are not ideal for PC2WE operations due to the potential for excessive exposure times. For this reason, pilots must not conduct this approach if obstacles in the baulked landing flight path require the virtual clearway to be raised.

Note: Due to the longer exposure time limit, the EC-145 could accept a maximum virtual clearway height of 80 ft for a 180 ft DPBL.

15.5.6 If OEI before the DPBL, conduct the CAT A VTOL baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary, then climb to a safe height.

15.5.7 If OEI after the DPBL the profile should allow continuation of the double-angle approach for a descent into the helipad to land with minimum speed for the surface conditions.

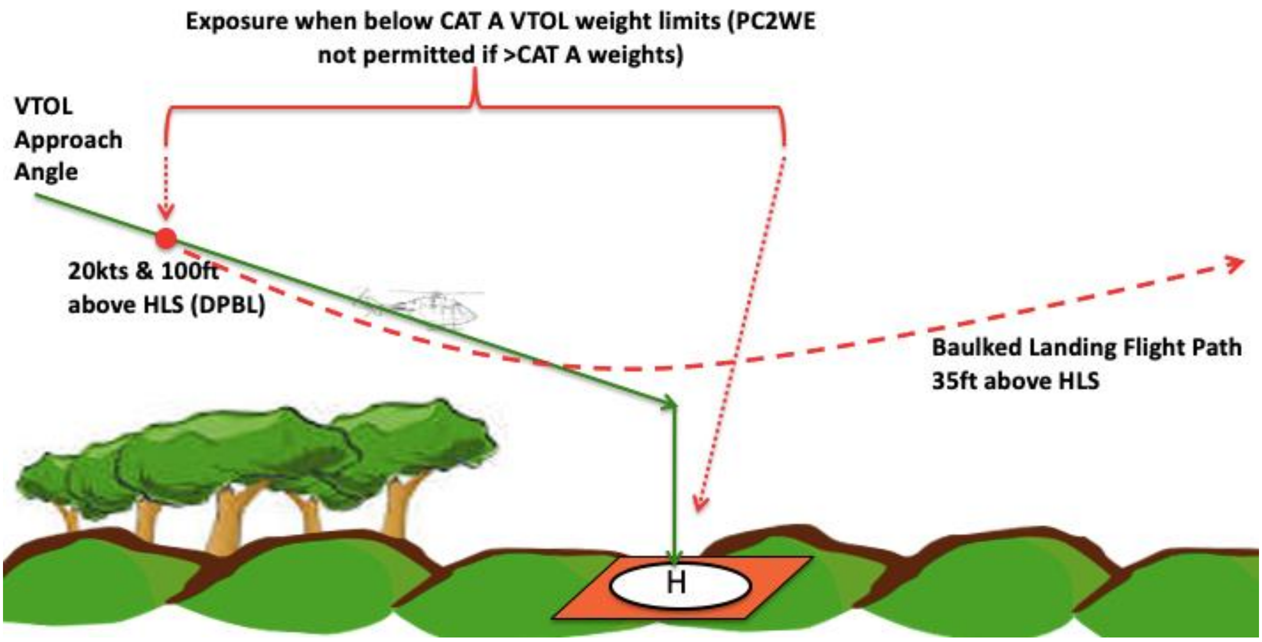

Figure 20: PC2WE obstructed helipad approach

15.6 PC2WE take-offs from elevated heliports / helidecks on critical infrastructure

15.6.1 This sub-section gives an option of lowering or raising the virtual clearway if supported by the pilot survey of a 270 m virtual clearway.

15.6.2 **If applying CAT A VTOL weights & procedures**: There is no exposure (PC2) if using a RP 140 ft above the virtual clearway.

> **Note:** The 300 kg increase in available payload for the LTS101-850 variant means PC2 operations without exposure is more feasible.

15.6.3 **If above CAT A weights**: This is the most critical PC2WE situation for elevated helidecks on top of critical infrastructure in populous areas, where a reject back to the helideck may not be an acceptable risk (Figure 21 below):

- Review areas in the take-off path as possible emergency landing areas.
- To minimise risk of a deck-edge strike, commence the take-off from a point with the rotor disc at the front edge of the helideck.
- Apply take-off power and rotate for take-off at 20 ft. DPATO will be when the pilot judges 50 KIAS and a positive climb 35 ft clear of obstacles can be achieved OEI. The exposure risk is from 12 ft until DPATO. Pilot judgement of DPATO will be based on their awareness of aircraft height loss performance, acceleration rates, and height above obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

15.6.4 If OEI after the DPATO, accelerate initially to 50 KIAS to commence a climb and, once at 200 ft (or 500 ft by night unaided), accelerate to 65 KIAS; then, turn to avoid obstacles as necessary and climb to a safe height.

15.6.5 If OEI before the DPATO and prior to rotate, reject the take-off to land back at the helipad. If OEI before DPATO, but after the 20 ft RP, attempt to land with minimum speed at the pre-identified emergency landing areas ahead.

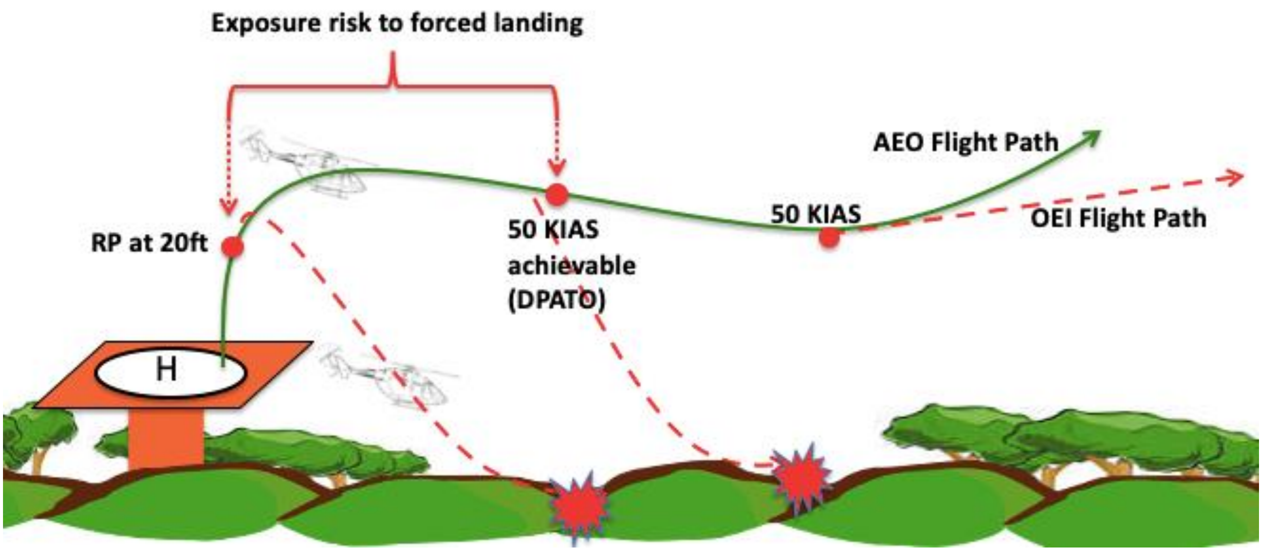

Figure 21: PC2WE Helideck take-off >CAT A

15.7 PC2WE approaches to elevated heliports / helidecks on critical infrastructure

15.7.1 Approaches to elevated heliports and helidecks on critical infrastructure must not be conducted unless a direct helipad approach angle, without a double angle, is possible. This removes the risk of a near vertical descent and engine power loss, leading to an excessively heavy landing.

15.7.2 If conducting a direct helipad approach and within the CAT A VTOL weight limits, PC2WE is not required as this would be PC2.

15.7.3 If conducting a direct approach, but above the CAT A VTOL weight limit, no exposure should be present under the PC2WE regime for the approach. With the required HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. However, pilots must use 40 KIAS and 100 ft above the virtual clearway as the basis for when they are committed to an OEI landing and can no longer achieve a safe baulked landing.

> **Note:** The assumption is that the normal approach angle will allow AEO power required to remain below 62% TQ and, therefore always allow the helipad to be reached.

15.8 Summary of PC2WE DPATO & DPBL

15.8.1 Table 12 below summarises the numbers discussed in sub-sections 15.2 to 15.7 above. In this table, Above Obstacles (AO) is taken to mean height above the established height of the virtual clearway. The common use of 12 ft refers to the base of the avoid area of the HV envelope (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(iii) & (vii)).

Table 12: PC2WE summary of exposure

Open Areas <CAT A	Exposure starts	Exposure Finishes
Take-Off	12 ft	40 KIAS (DPATO)

Open Areas <CAT A	Exposure starts	Exposure Finishes
Landing	Committed at 40 KIAS & 100 ft AO, but no exposure on a normal profile	
Ground Level or Elevated Helipad		
Vertical Take-off <CAT A	12 ft	140 ft AO (DPATO)
Vertical Take-off >CAT A	12 ft	40 KIAS + 35 ft AO (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 100 ft AO, but no exposure on a normal profile	
Landing double-angle <CAT A	20 KIAS & 100 ft above HLS (DPBL)	at helipad
Landing double-angle >CAT A	Not permitted	
Elevated Helipad (on critical infrastructure)		
Take-off >CAT A	12 ft	50 KIAS achievable (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 100 ft AO, but no exposure on a normal profile	

16 PC2WE Risk Assessments

16.1 Risk mitigation by CASA

16.1.1 CASA reviews the acceptability of an operator's PC2WE operations on the basis of compliance with the requirements of the Part 133 MOS, sections 10.11 to 10.16. These are summarised as:

- a maximum exposure time of 20 seconds (36 seconds EC-145), with anything above nine seconds that is supportable by engine power loss rates proportionally in excess of 1:100,000 hours
- having in excess of HOGE power margins
- all rotorcraft and engine preventative maintenance actions are completed
- risk assessment procedures for BK117 PC2WE operations are in place, including measures to mitigate the risk (refer to sub-section 16.2 below)
- operations are conducted in accordance with the RFM and this exposition
- flight crew training and checking is conducted in order to achieve competence in the flight procedures described in sections 13 to 15 of this Annex.

16.2 PC2WE risks and mitigation measures

16.2.1 This sub-section provides some, but not limiting, guidance to operators on the risks of operating PC2WE and possible mitigation measures. It is written on the assumption that an operator has achieved base-line compliance with the regulated control measures described above. This is meant as a start point to help operators integrate PC2WE risk assessments into their existing SMS risk register. Detailed risk statements, impacts, as well initial and residual risk levels should be determined in line with the operator's established risk assessment processes.

Table 13: PC2WE risks & possible mitigation measures

Risks	Mitigation measures
Pilot excessive focus on PC2WE compliance results in obstacle strike	• Exposition and training briefs highlight obstacle strikes as the highest risk in helipad environments. • Obstacle avoidance techniques are prioritised above engine failure considerations and techniques, due to the relative risk levels. • The company allows variations from compliance with PC2WE considerations to maintain overall safe operations, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system. • The pilot conducts a pre-departure review of the take-off path, likely obstacles, and determination of required performance to avoid obstacles in addition to PC2WE considerations.
Global fleet reliability reduces below the approved 1:100,000 engine power loss rate	• Company aircraft have historical engine failure rates of 0.43 per 100,000 hours, but apply a conservative rate of 0.45 per 100,000 hours. • Annual report has been obtained from Type Certificate Holder to state compliance with 1:100,000-hour engine failure rate target. • Company SMS tracks global accidents for company aircraft to establish early trends of engine failure rates.

Risks	Mitigation measures
Pilot techniques and / or environment require exposure periods greater than the exposure time limit	• The company can justify a 20-second exposure time limit based on power loss rates. • Use of the most limiting of CAT A Clear Heliport or 97% of HOGE as maximum weight provides sufficient power margin to remain within exposure time limits. • Exceeding 20 seconds exposure is only approved for MT or ESO operations at an MT or ESO Operating Site. • Non-MT / ESO operations are conducted to less complex landing sites than for MT / ESOs. • Pilot simulator (if available) or line training in vertical and oblique take-off and landing techniques, including awareness of the time it takes to conduct these at CAT A Clear Heliport or 97% HOGE weight limits. • Pilots are trained not to delay the DPATO any later than necessary, and to nominate a DPBL that is as late as possible in the approach. • Pilot training in accurate assessment of aircraft height / speed energy to allow for a safe fly-away (in simulator if available).
Pilot PC2WE performance assessment, procedures or flying techniques are inadequate or not understood	• Exposition has specific sections explaining PC2WE, what it is, and flying techniques to use. • Exposition describes pilot methods for determining obstacle gradients, and this is practiced in Line Training. • Training and checking is conducted in PC2WE techniques up to CAT A Clear Heliport and 97% of the HOGE weight limits (in simulator if available). • Co-pilot or Air Crew Member training in PC2WE requirements is provided so they can provide knowledge and procedural support for the pilot. • Variations from PC2WE are permitted, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system.
Pilot PC2WE performance procedures or flying techniques expose third party persons or things to unacceptable impacts of rotor downwash and outwash.	• Exposition procedures for ensuring the safety of people, animals, buildings and things during helicopter operations through the establishment of downwash/outwash protection safety distances for operations. • Liaison with regular use helicopter landing site and heliport operators regarding strategies for minimising the impacts of rotor downwash/outwash at these locations. For example, downwash/outwash protection zones. • Exposition procedures for crews to have operations specific awareness training on the size and effects of rotor downwash/outwash during PC2WE and other operations. • Initial and recurrent competency and proficiency assessments to ensure flight and other crew member awareness of the effects of rotor downwash/outwash during PC2WE and other operations. • Ground crew personnel trained in rotor downwash/outwash effects and safety procedures. • Exposition procedures to ensure operational crews conduct a pre-flight and in-flight operational risk assessment of potential rotor downwash/outwash effects.

Risks	Mitigation measures
The pilot training system is incomplete or ineffective	• Company conversion training includes a specific long brief on helicopter performance and PC2WE operations. • Six-monthly training sessions are conducted, including training and checking in PC2WE operations up to CAT A Clear Heliport and 97% HOGE weights (in simulator if available). • Line Training provides opportunities to train pilots in the application of obstacle surveys and PC2WE requirements. • Pre-take-off and pre-landing briefings require mention to the crew of whether ‘exposure’ is present, or not. • Six-monthly training meetings review standardization and effectiveness of the training system.
The required engine / airframe preventative maintenance is not conducted	• Aircraft maintenance is conducted in accordance with the CASA-approved System of Maintenance. • The company follows the preventative maintenance requirements recommended and / or approved by the OEM. • Engine modifications are not conducted without approval of the engine and airframe Type Certificate holder. • The Company Quality Assurance program assesses compliance with the System of Maintenance through an audit program. • Engine and drive-train heavy maintenance is conducted by a CASA and OEM-approved overhaul facility.
Usage Monitoring System fails to record or operate correctly	• Company OMEL requires a serviceable UMS for PC2WE operations. • UMS is maintained and data assessed as accurate in accordance with the CASA-approved System of Maintenance.

17 PC2WE operations EC135 P2 rotorcraft

17.1 Purpose of this section

17.1.1 The purpose of this section of the Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a CASR Part 119 exposition or a CASR Part 138 operations manual for PC2 with exposure (PC2WE) operations in the EC135 P2. It could also be used as a guide for operators using other EC135 variants. Noting that PC2WE operations are not mandatory for Part 138 operations. This will allow an AOC or Aerial Work Certificate holder to satisfy CASA of the PC2WE regulatory requirement if they choose to use and follow this section of the Annex. However, they may also propose alternative means of compliance to the AMC proposed here if they so desire. This alternative means will need to be assessed and found acceptable for the purpose by CASA.

17.1.2 Operators and flight crew members should develop an understanding of the performance class system, as detailed within AC 133-01 Performance Class Operations (AC133-01) and AC 133-02 Performance Class 2 With Exposure Operations (AC133-02), prior to reading this Annex.

17.1.3 In addition to the sections in this Annex on PC2WE, and if applicable to their operations, operators are required to detail the procedures for use during PC1, PC2 (without exposure) and PC3 operations in their exposition or operations manual. Guidance on what is required for these operations is contained within AC 133-01.

17.1.4 To maximise the benefit of PC2WE by keeping exposure times within limits, rotorcraft operators should encourage heliport operators to keep take-off and approach path obstacle-free gradients as low as possible. Failure to achieve this may mean PC2WE is not a viable option at that heliport.

17.1.5 The following sections 18 to 20 are written as AMC for direct transfer into company expositions or operations manuals for an EC135 operator. However, for simplicity, they are based on application of a limited number of Category A procedures, and they exclude the use of ‘drop-down’ procedures below the level of a helideck. Some operators may need to develop additional or replacement exposition material to cater for the specifics of their operations.

17.1.6 The policy of having no engine failure exposure risk from critical infrastructure is a limitation proposed by the example set out in the AMC of the Annex, however this is not a mandatory requirement for operators. Operators may propose alternative procedures to those suggested in sections 20.6 and 20.7.

17.1.7 In addition to the AMC provided in this Annex, operators should consider providing pilots with simplified tables or an electronic method for determining the required performance data so as to avoid potential error with using RFM charts.

17.1.8 Section 21 provides some guidance on how to develop the risk assessment for PC2WE operations.

17.1.9 In this document, reference is made to the Part 133 MOS; however, such referencing is not considered mandatory for an exposition or operations manual, with an expectation that referencing AC 133-01 and AC 133-02 as applicable will be sufficient for pilots.

18 Policy for EC135 PC2WE operations

18.1 Background

18.1.1 For maintenance of appropriate operational capability, the company has a requirement to conduct PC2WE operations.

18.1.2 Company approval to conduct PC2WE operations is predicated upon achieving CASA requirements for:

- a target level of safety
- engine reliability assessment
- continuing engine reliability assurance
- mitigating airworthiness procedures, and
- mitigating operational procedures and training (refer to CASA AC 133-02, section 3).

18.1.3 As part of the CASA approval process for PC2WE operations, the company has also completed an Operational Risk Assessment for PC2WE operations. This can be referenced at (insert manual reference).

18.1.4 PC2WE can allow greater operational flexibility for operations at higher weights, to and from heliports with more complex obstacle environments. From runway environments, PC2WE may not offer a weight advantage over PC2 because PC2WE HOGE weight limits are more limiting than CAT A runway requirements.

18.1.5 To maintain PC2WE safety risk at an appropriate level, CASA AC 133-02 provides guidance to operators and pilots in how to risk manage such operations. For a deeper understanding of PC2WE operations, pilots should become familiar with CASA AC 133-02.

18.1.6 EC135 P2 performance figures used are based on a post S/N 1055 or after SB EC135-62-028 aircraft, equipped with PW 206B2 powerplants, and with no sand-filter or IBF systems installed. Data is based on an aircraft certified up to 2,950 kg as described within FMS 9.1-6 and 9.1-7. They are considered to have no heater or air conditioning systems operative during take-off or landing procedures. Pilots must note that configurations that vary from that described above will require different performance figures to what is mentioned in these sections.

18.1.7 In consideration of achieving simplicity in operations and training for PC2WE, company pilots are limited to the following Flight Manual Category A procedures from FMS 9.1-5:

- Clear Heliport
- VTOL(1) – Surface Level or Elevated Heliports.

18.1.8 The company Training Manual details the additional flight crew training and checking requirements for the procedures described within this section. Before using PC2WE in line operations company flight crew members must complete and been found competent in accordance with the training and checking manual PC2WE requirements outlined therein.

18.1.9 Although PC1 and PC2 operations should be conducted wherever operationally possible, PC2WE is the minimum standard for the following types of Air Transport operations (refer regulation 133.335 of the CASR):

- passenger transport operations under night VFR or IFR
- medical transport operations (compliance with a performance class is not mandatory at a Medical Transport Operating Site (refer regulation 133.315), provided such operations are conducted in accordance with this exposition). The main utility for PC2WE in Medical Transport operations will be to / from hospital heliports where Category A limits and procedures cannot be applied.

18.2 EC135 relevant characteristics and assumptions

18.2.1 The overall length (D-value) for the EC135 is 12.16 m. This is relevant for the dimensions of the heliport FATO and Safety Area. A heliport of insufficient size to meet PC2 requires PC2WE operations.

18.2.2 The rotor radius (R) for the EC135 is 5.1 m. This is applicable for defining the area to survey beyond DPATO for take-off path obstacles.

18.2.3 Because PC2WE operations do not mandate the use of Category A procedures, targeted selection of the various Category A procedures and associated performance are used by the company to achieve PC2WE compliance. From these, the following assumptions may be made for the company operating environment, and they are summarised in Table 14 below:

- For any Category A Clear Heliport take-off procedure, the worst-case rejected take-off distance required is 280 m. Distances less than this will require PC2WE.
- For any RFM Category A Clear Heliport or VTOL(1) take-off or landing procedure, the worst-case OEI take-off or baulked landing distance required is 230 m. The 230 m may either be available horizontally directly from the take-off point, or it can be achieved using a virtual clearway creating a raised incline plane for the OLS (refer to CASA AC 133-01, sections 6.4 and 6.5).
- For any Category A Clear heliport / VTOL(1) take-off or landing procedure, the worst case OEI acceleration distance from VTOSS to Vy is 470 m for Clear heliport and 350 m for VTOL(1)

> **Note:** If there is a relatively shallow VTOSS OEI climb gradient combined with the acceleration component to get from VTOSS to Vy, there is a risk that any OLS commencing from the end of the take-off distance could be impinged by the OEI flight path before Vy is achieved. The methods suggested in this section of the Annex will ensure the 35 ft OLS clearance requirement is met.

- For any CAT A Clear Heliport landing procedure, 220 m is the worst-case OEI landing distance required.
- For any Clear Heliport landing when below the CAT A weight limit, the OEI height loss from the 80 ft LDP is 45 ft.
- For any VTOL(1) take-off or landing when below the CAT A weight limit, the OEI height loss from TDP or LDP is 85 ft. PC2WE operations are not permitted if the TDP or LDP for the procedure is required to be any higher than 180 ft (36 seconds) above the heliport.

Table 14: EC135 standard performance figures

Scenario up to 3,500 Ft and 35° C	Standard figure
CAT A Clear heliport worst-case rejected take-off distance required (FMS 9.1-5, Figure B10)	280 m
CAT A Clear heliport or VTOL(1) worst-case take-off or baulked landing distance required. (FMS 9.1-5, Figure B11).	230 m
CAT A Clear heliport or VTOL(1) most limiting acceleration distances required (FMS 9.1.5, Figure B12)	470 m and 350 m
CAT A Clear Heliport most limiting landing distance required (FMS 9.1-5, Figure B14).	220 m

Scenario up to 3,500 Ft and 35° C	Standard figure
Height loss from CAT A Clear Heliport LDP.	35 ft
Maximum height loss from CAT A Helipad TDP / LDP.	85 ft

18.3 Maximum permitted exposure time

AMC for Part 133 MOS, section 10.11.

18.3.1 Current engine reliability data from Airbus Helicopters for the EC-135 allows approved rotorcraft a maximum permitted exposure time of 36 seconds, based on it meeting or exceeding an engine power loss rate of 0.25:100,000 hours.

18.3.2 Pilots are to ensure that the take-off and landing techniques used for PC2WE require no more than 36 seconds of exposure. If this is not possible, the PIC must take steps to reduce weight and / or adopt alternative techniques such that the maximum exposure time is not exceeded.

18.4 PC2WE limitations & performance charts

AMC for Part 133 MOS, section 10.12.

18.4.1 This sub-section details company operating limitations, and relevant performance charts for PC2WE, including those for determining take-off weight limitations to meet the requirements of section 10.12 of the Part 133 MOS. The company will provide pilots with extracts of the relevant charts (or tabulated / computerised data), per Table 15 below, for determination of PC2WE performance.

Table 15: RFM performance chart reference

Limitation	Reference chart
3.8% OEI (150 fpm) gradient at 40 KIAS, or 8.0% if over populous areas	FMS 9.1-5, Figure A8
2.3% (150 fpm) at 65 KIAS to 1,000 ft	FMS 9.1-5, Figure A12
50 fpm OEI ROC at MCP and 65 KIAS	FMS 9.1-5, Figure A16

18.4.2 Category A Clear Heliport and VTOL limitation charts are not included for discussion in this section, as they are more specifically applicable to PC1 and PC2 operations. However, operations within the CAT A VTOL weight limits will help to reduce the exposure risk.

18.4.3 A requirement of PC2WE is to ensure the aircraft is capable of AEO hover out of ground effect (HOGE) performance that allows an acceleration from a vertical climb into forward flight. Compliance with this requirement will be achieved if the weight allows an OEI rate of climb at 40 KIAS of greater than 150 ft / min (3.8%).

18.4.4 Pilots must ensure that, for PC2WE operations, the aircraft weight at take-off or landing is not greater than that required to achieve an OEI rate of climb of 150 fpm (equates to 2.3% at 65 KIAS) 1,000 ft above the heliport. In these calculations, wind benefit must not be applied. This is the usual limiting condition for PC2WE.

For example, at 2,800 kg, 37° C and 1,000 ft the OEI climb gradient is 3.5% at 65 KIAS

18.4.5 The EC135 CAT A procedures have a level acceleration segment to accelerate at 200 ft from 40 KIAS to 65 KIAS. This can serve to complicate calculations for confirming if the aircraft will remain 35 ft clear of the OLS. Section 20 below provides procedures for pilots to follow that will give this assurance, but with some limitations in raising the virtual clearway and rotate point.

18.4.6 To provide additional OEI power margins and reduce risk over populous areas, pilots must also ensure that, for company PC2WE operations over populous areas, the aircraft weight at take-off or landing is no greater than that required to achieve a 40 KIAS OEI rate of climb at 2-min power of 8.0%, at 1,000 ft above the heliport. In these calculations, wind benefit must not be applied.

For example, at 2800 kg, 28° C and 1,000 ft OEI climb gradient is 8.0% (refer to CASA AC 133-02, sub-section 2.9.2).

Note: AC 133-02, sub-section 2.9.2, indicates that 8.0% is not mandatory however, the company has incorporated this into the standard operating procedures as a safety enhancement.

18.4.7 Pilots must ensure that above the lower of DPATO / DPBL or 300 ft, the OEI gradient of climb is greater than or equal to the take-off path obstacle-free gradient (also known as the Obstacle Limiting Surface (OLS) gradient). OLS gradients for commonly used heliports are indicated in the company helipad register. Otherwise, they should be calculated as described in sub-section 19.3 below.

18.4.8 As for PC1 and PC2, the OEI rate of climb at the minimum altitude must be at least 50 fpm. The minimum altitude for Day VFR and NVIS flight is 1,000 ft, and for night unaided or IFR flight is LSALT or MSA.

18.4.9 For example, 50 fpm is achievable up to 2,800 kg and 24° C at 6,000 ft, so this should rarely be a limiting factor for company EC135 operations.

18.4.10 When conducting Clear Heliport or open area operations, pilots must confirm that the available smooth, firm, level surface suitable for a rejected take-off is greater than the 280 m rejected take-off distance required. If the available distance is less than 280 m, PC2WE is required.

18.4.11 When operating from elevated heliports and helidecks, the VTOL(1) procedure may be used. If built on top of critical infrastructure or occupied buildings, pilots must not, for any take-off, accept an engine failure exposure risk that involves rejecting back to the building, after entry into the avoid area of the HV envelope (10ft). This means a rejected take-off to the heliport or helideck must not be conducted unless within the CAT A VTOL(1) weight limits.

18.5 Suitable Forced Landing Area

18.5.1 Exposure can be avoided if usable reject or OEI landing areas can be classified as a suitable forced landing area. The area can be considered suitable if it meets the requirements for a PC2 heliport as discussed in sub-section 19.1 below, and which also equates to the RFM ‘smooth, firm, and level surface’, as discussed under the height-velocity limitations section of the RFM. Pilots must assess potential suitable forced landing areas by referencing the company heliport register for a known location or on the basis of the guidance in CASA AC 133-01, section 4.1.

18.5.2 Water landing areas, when assessed as suitable by the company SMS, can also be considered as suitable forced landing areas for the EC135. The aircraft must be fitted with an approved emergency flotation system and operated in not greater than sea state 6 conditions. However, there must also be a reasonable expectation of rescue within survival times, and the operations be in areas where search and rescue capabilities are available. For the purpose of this requirement, the company defines the boundaries of areas where SAR capability is available at (insert company manual reference) of this exposition.

18.5.3 Regardless of the quality of the forced landing area, it is not considered suitable for PC2 operations if an attempted OEI landing is made from inside the avoid area of the HV envelope, unless below the applicable CAT A weight limits or during a normal angle approach. Likewise, for an area to be suitable during a clear heliport or open area rejected take-off, the smooth, firm and level surface available (runway plus possible stopway) must exceed the RFM rejected take-off distance required (refer to Part 133 MOS, subparagraph 38(f)(ii)). In the EC135, it can be up to 400 m, so pilots must have an awareness of this distance, particularly from very short areas so they can determine the need for PC2WE.

18.6 Height-Velocity limitations

AMC for Part 133 MOS, section 2.02.

18.6.1 PC2WE operations are not required if entry into the avoid area is part of:

- a take-off, landing, or hover (including winching) operation at a medical transport operating site
- winch operations with OEI HOGE performance, or
- when operating within RFM CAT A limitations and procedures (this would be PC2 at least).

18.6.2 Other than as mentioned above, any operational requirement to enter the avoid area of the HV envelope during take-off will require pilots to ensure PC2WE requirements can be met, even if a suitable forced landing area is available.

18.6.3 For the EC135, pilots can assume they are outside of the avoid area of the HV envelope if below 10 ft and faster than 25 KIAS.

18.6.4 Operations outside the avoid area of the HV envelope will still require PC2WE operations if a suitable forced landing area is not available, or if a safe OEI flyway is not possible.

18.7 Adequate Vertical Margin

AMC for Part 133 MOS, section 10.02 & 10.30.

18.7.1 As part of the PC2WE requirements, prior to DPATO and after DPBL, pilots must fly the aircraft to avoid all obstacles by at least an adequate vertical margin.

18.7.2 The company defines 10 ft (3.0 m) as an adequate vertical margin for the EC135. However, under the following circumstances pilots must use at least 15 ft (4.5 m) as an adequate vertical margin:

- when the physical nature of the obstacles makes depth perception difficult
- when visibility is degraded due to precipitation, bright lights, or windshield obscurants
- at the pilot’s discretion.

19 EC135 Survey Procedures

AMC for Part 133 MOS, section 10.32(6).

19.1 Instructions for heliport survey

19.1.1 PC2WE operations could mean exposure to an OEI landing risk on a sub-standard reject area, and / or exposure to a flyaway risk. Pilots are to determine whether the proposed OEI reject area requires PC2WE.

19.1.2 Except in the case of extreme surface conditions such as swamp, marshland or heavily ploughed fields, surface strength of ground level areas never requires PC2WE provided the size and slope are within the limits mentioned below. PC2WE operations to elevated heliports / helidecks must not be conducted above the stated weight limits for those structures.

19.1.3 PC2WE is required for any rejected take-off or OEI landing area if:

- the diameter of area is less than 25 m. This may be measured through use of mapping applications, by pacing the area, or if an airborne assessment may be based on pilot judgement and comparison with known area sizes.
- using a CAT A Clear Heliport take-off profile the reject distance available is less than the reject distance required (refer to sub-section 18.5.3 above)
- the mean slope of the area is greater than 5°.

19.2 Instructions for obstacle survey

19.2.1 Pilots are permitted to conduct airborne or ground surveys of PC2 and PC2WE take-off and approach paths for determination of relevant obstacles in accordance with this sub-section (refer to Part 133 MOS, subsection 10.32(6)).

19.2.2 Surveys of certified or registered instrument runways are not required, but prior to using these runways pilots must access the OLS gradient and Accelerate Stop Distance Available (ASDA) from the ERSA Runway Distance Supplement (ASDA is the same as the rejected take-off distance available and includes the runway length plus stopway).

19.2.3 Due to the complexity of conducting a pilot survey, where possible, pilots are to take advantage of existing heliport obstacle survey information provided in AirServices Australia documentation or in the company heliport register for commonly used heliports. These surveys are normally compliant with a 4.5% OLS gradient from the edge of the FATO to 500 ft, within a 9° (15%) splay left and right of the FATO edge.

19.2.4 Survey information received on the same day from other company pilots may be used provided their use of the heliport was in the last 12 months.

19.2.5 Pilot surveys must only be conducted by day or at night using NVIS.

19.2.6 As discussed in sub-section 18.2.3 above, 230 m is the worst-case take-off or baulked landing distance required for Clear Heliport or VTOL(1) procedures. This means that following an engine failure, it could take up to 230 m before the aircraft can enter a 40 KIAS climb. For this reason, a virtual clearway should be established extending 230 m from the FATO. From that point an OLS gradient can be established.

19.2.7 If conducting a VTOL(1) take-off profile, and obstacles are present within the first 230 m, the virtual clearway must be raised to the level of those obstacles creating a raised incline plane for the OLS. If there are relevant obstacles beyond the take-off distance required, the virtual clearway may also need to be raised to achieve a desired OLS gradient. Combined with a raising of the TDP or rotate point, this ensures that the OEI flight path still remains 35 ft (10.7 m) above the obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)). Also refer to CASA AC 133-01, section 6.4.2, and Figure 22 below.

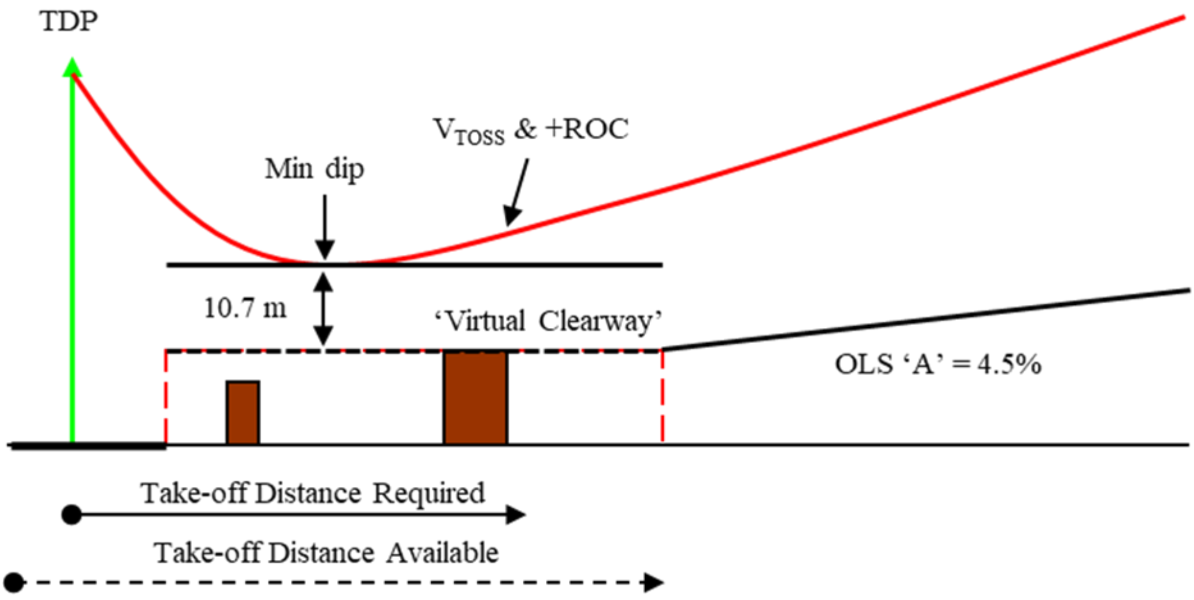

Figure 22: OLS gradients & raised virtual clearway

19.2.8 For company operations, pilots must assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7.0 km. Noting that turns are permitted to avoid obstacles once at 200 ft above obstacles by day or on NVIS, or above 500 ft by night unaided, the unavoidable obstacle creating the steepest gradient within this area will be the limiting obstacle. If obstacles at the splay edges are of concern, the splay can be limited to a width of 51 m either side of the take-off path.

19.2.9 Determine the OLS gradient to the limiting obstacle by estimating the height above the raised incline plane, and distance from the end of the virtual clearway. Mapping applications may be used to assist, but pilots may also estimate heights based on obstacle heights of familiar features such as domestic power poles (10 m).

OLS gradient = 100 x (height of obstacle above raised incline plane) /

(distance to obstacle from end of virtual clearway)

Note: It is acknowledged that the limiting obstacle may not be visible from the helipad due to obstructions in the immediate vicinity. However, it is acceptable for a pilot to use their judgement of heights and distances based upon the nature of local vegetation and terrain, and information obtained from mapping applications.

19.2.10 If the calculated OLS gradient exceeds the aircraft's OEI climb gradient to 1,000 ft, the pilot must either plan to conduct a turn back to overhead before reaching the critical obstacle or reduce the OLS gradient by further elevating the raised incline plane. For example, an obstacle 60 m (200 ft) above the raised incline plane, and 500 m from the end of the virtual clearway produces a gradient of 12%. However, if the incline plane is raised by a further 30 m (100 ft), the new calculation would be 100 x 30 / 500 = 6%, which may be achievable by the aircraft. As mentioned earlier, any raising of the incline plane and virtual clearway will also require an upwards correction of the TDP or rotate point for any helipad take-off (refer to Part 133 MOS paragraph 10.12(d)).

19.3 Summary of PC2WE survey requirements

AMC for Part 133 MOS, paragraph 10.28(3)(b).

19.3.1 Helipad diameter must be greater than 25 m and slope less than 5° to avoid exposure during any rejected take-off or OEI landing.

19.3.2 Assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 7 km.

19.3.3 Identify the highest obstacle in the splay, above or below the helipad, within 230 m. This must be applied to the height of the virtual clearway.

Note: Temporary obstacles such as cranes and other temporary structures also need to be considered.

19.3.4 Within the splay, assess the height and distance of the limiting obstacle relative to the end of the virtual clearway.

19.3.5 Calculate the OLS gradient to the limiting obstacle from the end of the virtual clearway and ensure this is less than the aircraft OEI climb gradient to 1,000 ft, and less than 4.5%. If greater than 4.5% raise the virtual clearway (refer to Part 133 MOS, paragraph 10.12(d)).

19.3.6 Adjust the rotate point or TDP to ensure 35 ft clearance from the height of the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)).

19.4 Use of an error budget

19.4.1 Because PC2WE involves various performance calculations, plus pilot visual assessments of dimensions, slopes, heights and distances, all of which are prone to error, it is prudent to ensure there are tolerances for error. The company has the following control measures in place to ensure an appropriate margin of error is available:

- A maximum weight that provides 150 fpm OEI rate of climb at 40 KIAS gives an excess of HOGE performance.
- PC2WE must not be conducted for approaches to obstructed helipads unless a CAT A Clear Heliport approach angle can be flown to a point in space above the helipad (double-angle).
- Wind benefit must not to be considered for PC2WE performance calculations, as this can be unreliable and adds complexity to the gathering of performance data.
- The use of a worst case 230 m take-off distance required plus 470 m acceleration distance is normally in excess of what is actually required.
- The use of an assumed 0.25:100,000-hour engine power loss rate is higher than the reported rate.

20 Flight Procedures

20.1 Take-off and landing common calculations

20.1.1 The following information must be determined prior to all take-offs and landings for the expected weights, altitude and temperature of operations. This may be done on a worst-case basis of weights, altitudes and temperatures to cover multiple take-offs and landings (refer to Part 133 MOS, paragraph 10.28(3)(a)):

- Confirm if the aircraft weight and / or obstacle environment allow the use of CAT A VTOL to meet PC2.
- For the take-off and baulked landing flight paths, determine the OEI climb gradient at 65 KIAS, MCP and 1,000 ft (refer to Part 133 MOS, paragraph 10.12(c), subparagraph 10.12(f)(i) and subparagraphs 10.28(3)(c)(ii) & (vi)).
- For the take-off and baulked landing flight paths, confirm the OEI climb gradient at 40 KIAS and 2-min power is greater than 150 fpm (3.8%).
- If over populous areas, confirm the OEI climb gradient at 40 KIAS and 2-min power is at least 320 fpm (8.0%).
- Conduct the take-off path survey as per sub-section 19.3 above, and if turns are not planned until after the critical obstacle, ensure the OLS gradient is less than the 65 KIAS OEI climb gradient and is less than 4.5%.
- Identify visually, and / or with maps, the optimal flight path to follow if OEI after DPATO or before DPBL, but only allow for turns once above 200 ft (500 ft if night unaided) (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(i) & 10.28(3)(c)(v)).
- Determine OEI rate of climb at 65 KIAS and MCP, at 1,000 ft AGL for Day VFR or NVIS, otherwise at LSALT, is at least 50 fpm (refer to Part 133 MOS, paragraph 10.12(e); subparagraphs 10.28(3)(c)(iv)).

20.2 Take-off from open areas unsuitable for a rejected take-off

20.2.1 This procedure could be used from treeless paddocks or open fields that are unsuitable for a rejected take-off. This sub-section assumes the immediate lift-off area is of a suitable size and slope for a forced landing.

20.2.2 Conduct the initial take-off vertically, using up to take-off power, until 150 ft above the heliport then rotate to fly the Clear Heliport procedure. Exposure commences from entry into any HV avoid area (10 ft) and finishes at the DPATO of 40 KIAS (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

Note: The 150 ft maximum allows 30-secs to reach 150 ft then 6-secs to accelerate to DPATO.

20.2.3 If OEI after the DPATO, continue with the CAT A Clear Heliport OEI procedure and, if necessary, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles by at least 50 ft and climb to a safe height. Note that the aircraft loses 1.5% climb gradient during 15° angle of bank turns (FMS 9.1-5, Page 23).

20.2.4 If OEI before the DPATO, conduct the rejected take-off procedure to land in the safest area available with minimum speed for the surface conditions.

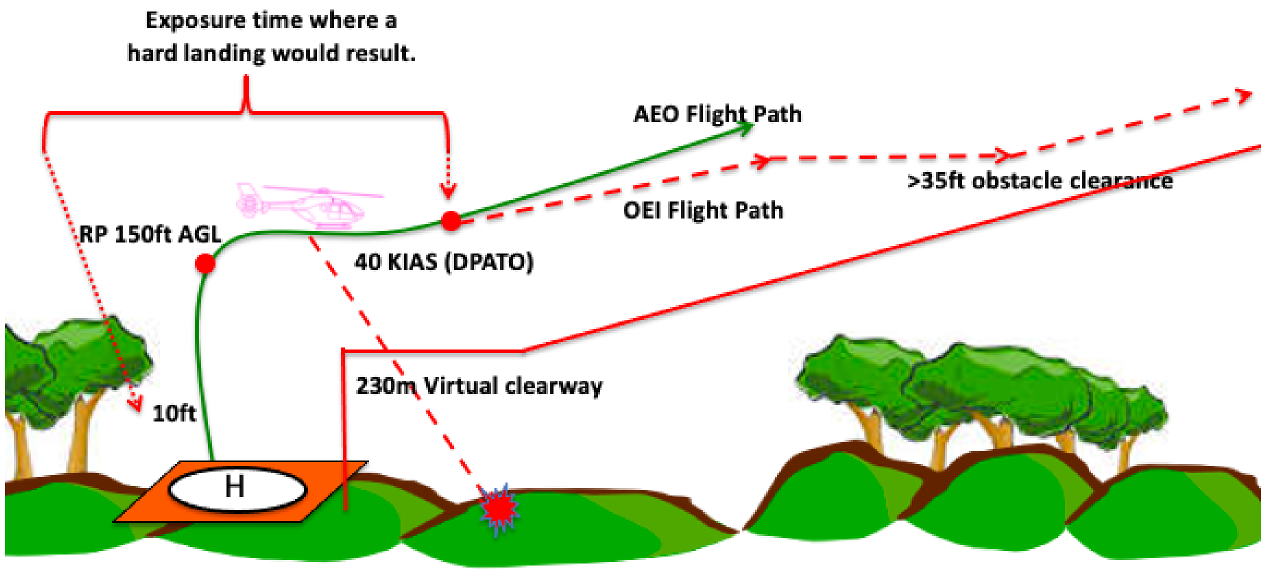

Figure 23: PC2WE open area take-off

20.3 Approach to open areas unsuitable for a run-on landing

20.3.1 This sub-section assumes that obstacles on the approach will allow the CAT A Clear Heliport profile to be flown. If not, apply the procedures for a helipad as discussed later in this section.

20.3.2 If a direct approach is possible, no exposure should be present under the PC2WE regime to a suitable helipad. With the required HOGE power margins, and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. For the clear heliport profile, pilots should use an airspeed of 40 KIAS and a height of at least 80 ft above the virtual clearway (as dictated by the landing site), as the basis for when they are ‘committed’ to an OEI landing and can no longer achieve a safe baulked landing. As for the take-off, 50 ft is the maximum virtual clearway permitted for a 4.5% OLS, unless the "committed point" is corrected an equal amount upwards (Figure 24 below).

Note: The assumption is that the approach will allow AEO power required to remain below 64% TQ (equivalent to 128% OEI TQ) and so always allow the helipad to be reached.

20.3.3 If OEI before the committal point (DPBL), conduct the CAT A Clear Heliport baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

20.3.4 If OEI after the committal point, continue the approach to land at the helipad with minimum speed for the surface conditions.

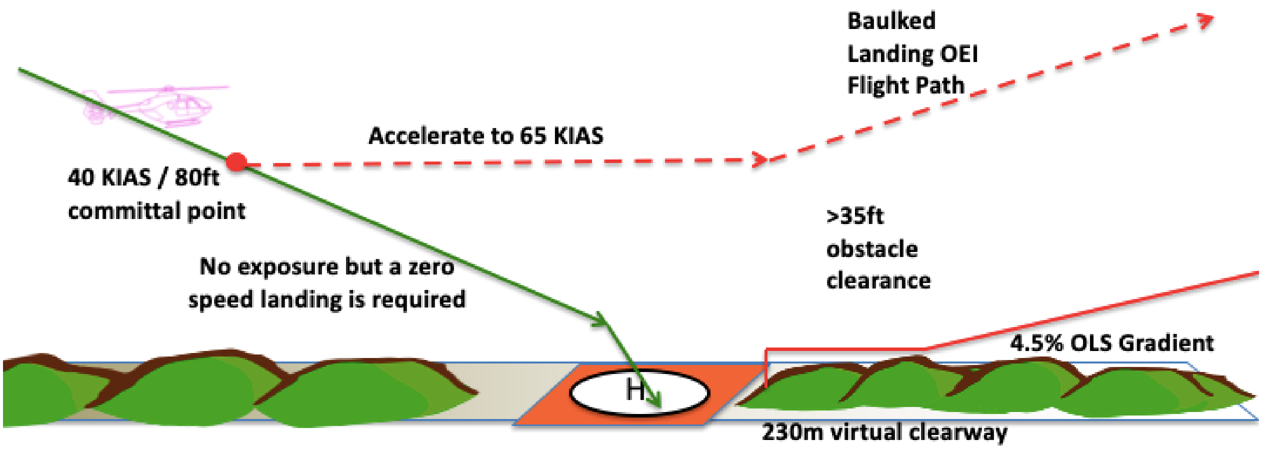

Figure 24: PC2WE open area approach

20.4 PC2WE take-offs from heliports and helidecks

20.4.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

20.4.2 These helipads are assumed not to be on top of critical infrastructure but provide a surrounding visual cuing environment sufficient for pilot reference to be maintained during extended vertical take-offs.

20.4.3 Confirm the helipad allows for the CAT A VTOL(1) back-up procedure to be conducted. This means that, to retain an appropriate obstacle clearance for a reject, there must be no obstacles within a 10° splay higher than an 8° slope, from 16 m rear of the take-off point, back to 200 m (FMS 9.1-5, Figure C23). If obstacles are present and do not allow this procedure, the vertical procedures described later in this sub-section must be applied instead.

> **Note:** The maximum back-up distance of 200 m is based on using the maximum TDP or rotate point of 300 ft.

20.4.4 Conduct the take-off using the CAT A VTOL(1) procedure and:

- **If below CAT A weights**: TDP at 130 ft above the virtual clearway and allowing for a 4.5% OLS there will be no exposure (PC2).
- **If below CAT A weights but unable to back-up (Figure 25)**: Conduct a vertical take-off using up to take-off power and rotate at 130 ft above the virtual clearway up to a maximum of 180 ft. Exposure will be from 10 ft until the RP (DAPTO).

> **Note:** **The** 130 ft **rotate points allow** the required margin **above the OLS, provided the subsequent OEI rates of climb also exceed the OLS gradient**. 180 ft maximum is due to the exposure time limits.

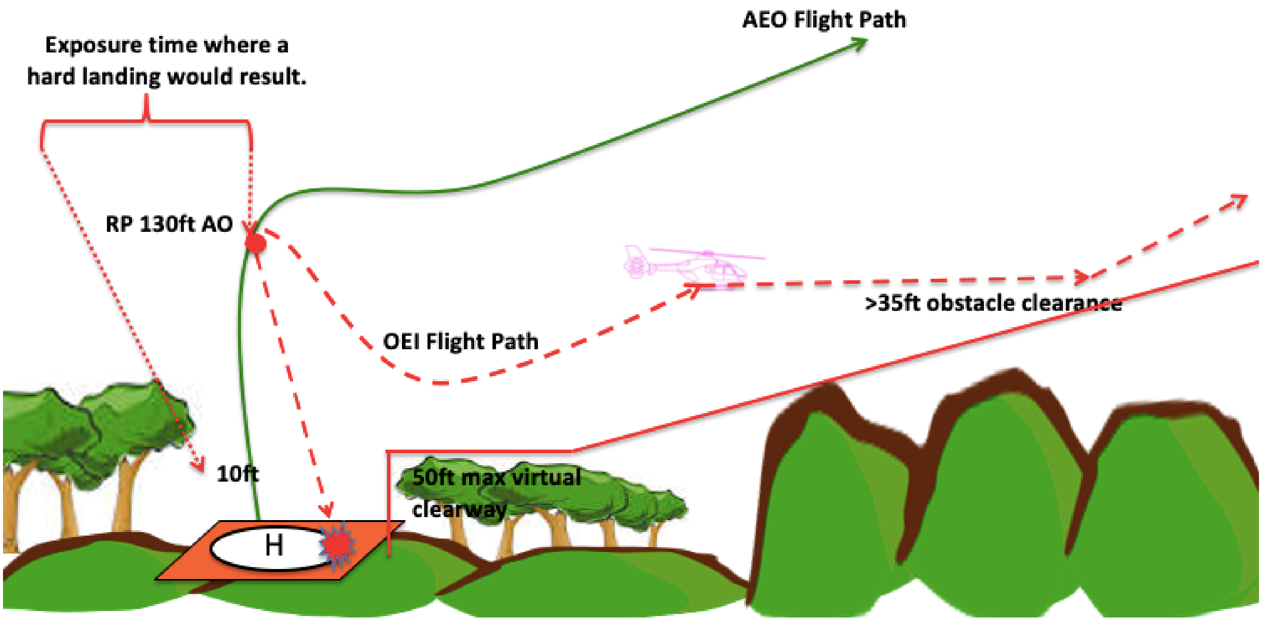

Figure 25: PC2WE Vertical take-off <CAT A

- **If above CAT A weights (Figure 26)**: It is the same procedure as for the open area take-off in sub-section 20.2 above and assumes a 4.5% OLS. Conduct a vertical or back-up take-off using up to take-off power, then from 150 ft above the heliport rotate to accelerate horizontally. Exposure will be from 10 ft until 40 KIAS (DPATO).

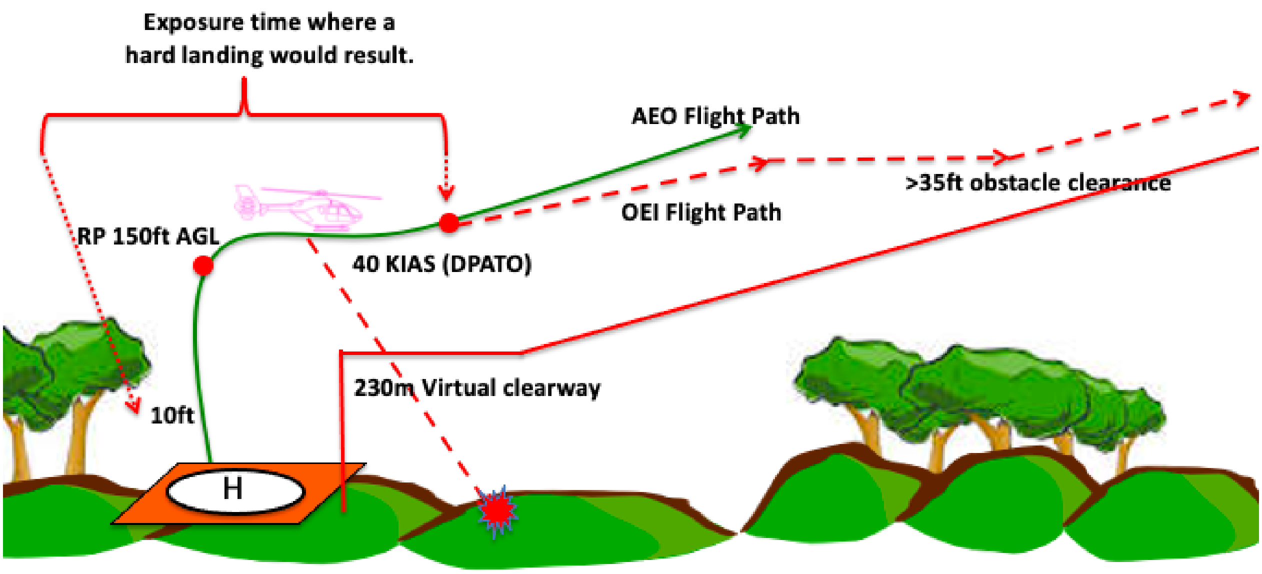

Figure 26: PC2WE Vertical take-off >CAT A

20.4.5 If OEI after the DPATO, accelerate to 40 KIAS and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

20.4.6 If OEI before the DPATO, reject the take-off to land back at the helipad, or reject the take-off to land in the safest area available with minimum speed for the surface conditions.

20.5 PC2WE approaches to heliports and helidecks

20.5.1 This sub-section can apply to heliports where obstacles allow a direct approach to a surface level or elevated heliport / helideck, or where the obstacles do not allow the CAT A VTOL(1) approach profile. The difference is that, if obstacles are present, the approach will become a double-angle approach.

20.5.2 If a direct helipad approach is possible, and within the CAT A VTOL(1) weight limits, PC2WE is not required as this would be PC2.

20.5.3 If a direct heliport approach is possible, but above the CAT A VTOL(1) weight limit, no exposure should be present under the PC2WE regime. With the required HOGE power margins and provided that a normal CAT A VTOL(1) approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown on a suitable area. However, pilots must use 40 KIAS and 80 ft above the virtual clearway as the basis for when they are 'committed' to an OEI landing and can no longer achieve a safe baulked landing.

> **Note:** The assumption is that the VTOL(1) approach will allow AEO power required to remain below 64% TQ and so always allow the helipad to be reached.

20.5.4 If a double-angle approach is required **aircraft weight must be below the CAT A Clear Heliport weight limits**. In such cases fly the CAT A Clear Heliport approach profile to a double-angle. Exposure commences at 40 KIAS and 80 ft above any virtual clearway and finishes at the helipad (Figure 27 below). However, double-angle approaches are not ideal for PC2WE operations due to the potential for excessive exposure times. For this reason, **pilots must not conduct this approach if obstacles in the baulked landing flight path are higher than 100 ft** (based on a 300 fpm rate of descent from a 180 ft DPBL).

20.5.5 If OEI before the DPBL, conduct the CAT A Clear Heliport baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

20.5.6 If OEI after the DPBL, the profile should allow continuation of the double-angle approach for a descent into the helipad to land with minimum speed for the surface conditions.

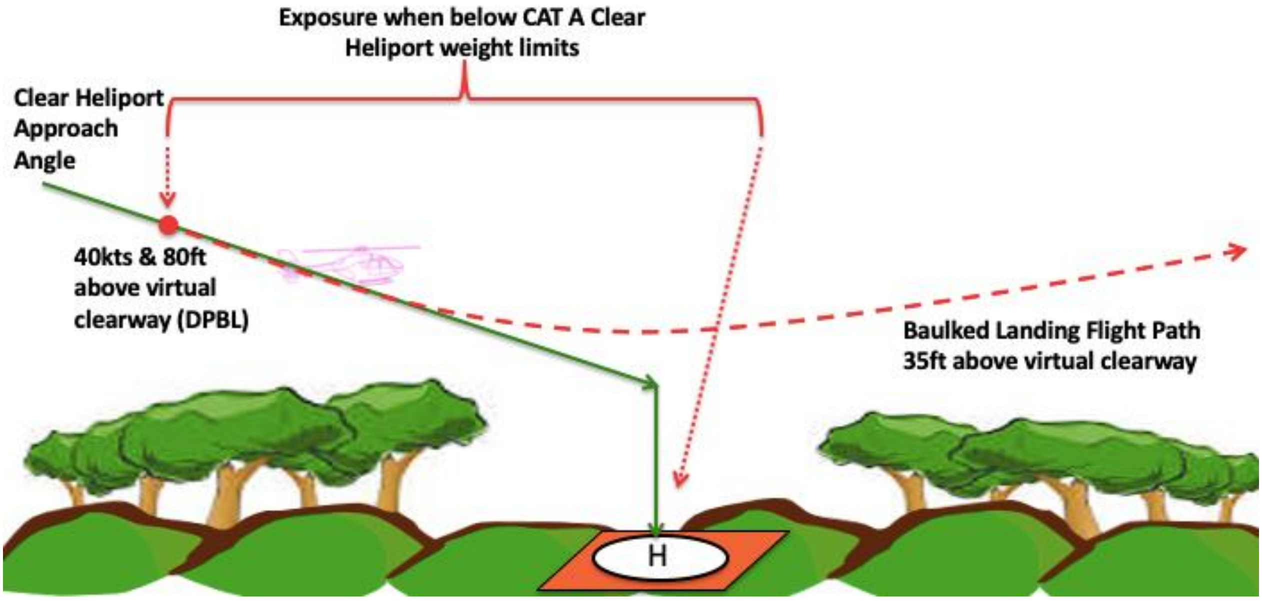

Figure 27: PC2WE obstructed helipad approach

20.6 PC2WE take-offs from elevated heliports and helidecks on critical infrastructure

20.6.1 This sub-section gives an option of lowering or raising the virtual clearway if supported by the pilot survey of a 230 m virtual clearway.

20.6.2 **If applying CAT A VTOL(1) weights & procedures**: There is no exposure (PC2) if using a RP 130 ft above the virtual clearway. This is higher than the RFM TDP, as it assumes a 4.5% OLS.

20.6.3 **If above CAT A weights**: This is the most critical PC2WE situation for elevated helidecks on top of critical infrastructure in populous areas, where a reject back to the helideck may not be an acceptable risk (Figure 28 below):

- Review areas in the take-off path as possible emergency landing areas.
- To minimise risk of a deck-edge strike, commence the take-off from a point with the rotor disc at the front edge of the helideck.
- Apply power to take-off power and rotate for take-off at 20 ft. DPATO will be when the pilot judges 40 KIAS and a positive climb 35 ft clear of obstacles can be achieved OEI. The exposure risk is from 10 ft until DPATO. Pilot judgement of DPATO will be based on their awareness of aircraft height loss performance, acceleration rates and height above obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

20.7 PC2WE approaches to elevated heliports and helidecks on critical infrastructure

20.7.1 Approaches to elevated heliports and helidecks on critical infrastructure must not be conducted unless a direct helipad approach angle, without a double angle, is possible. This removes the risk of a near vertical descent and engine power loss leading to an excessively heavy landing.

20.7.2 If conducting a direct helipad approach, and within the CAT A VTOL(1) weight limits, PC2WE is not required as this would be PC2.

20.7.3 If conducting a direct approach, but above the CAT A VTOL(1) weight limit, no exposure should be present under the PC2WE regime for the approach. With the required HOGE power margins and provided that a normal clear heliport approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. However, pilots must use 40 KIAS and 80 ft above the virtual clearway as the basis for when they are committed to an OEI landing and can no longer achieve a safe baulked landing (maximum permitted virtual clearway height is 100 ft).

Note: The assumption is that the heliport approach will allow AEO power required to remain below 64% TQ and so always allow the helipad to be reached.

20.7.4 If OEI after the DPATO, accelerate initially to 40 KIAS to commence a climb and, once at 200 ft (or 500 ft by night unaided), accelerate to 65 KIAS then turn to avoid obstacles as necessary and climb to a safe height.

20.7.5 If OEI before the DPATO and prior to rotate, reject the take-off to land back at the helipad. If OEI before DPATO, but after the 20 ft RP, attempt to land with minimum speed at the pre-identified emergency landing areas ahead.

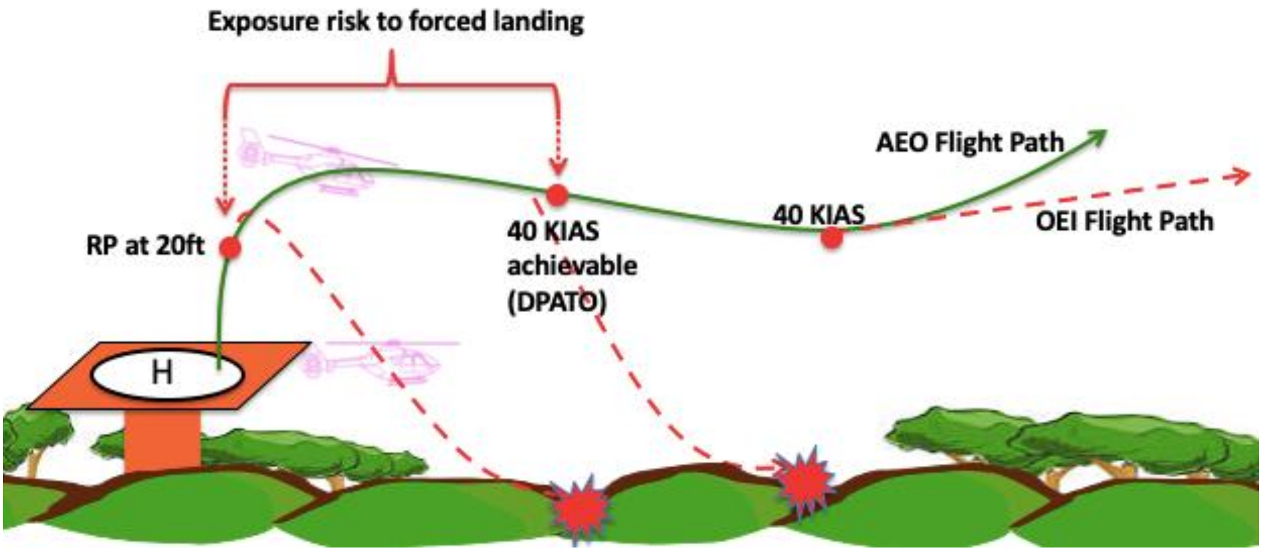

Figure 28: PC2WE Helideck take-off >CAT A

20.8 Summary of PC2WE DPATO & DPBL

20.8.1 Table 16 below summarises the numbers discussed in sub-sections 20.2 to 20.7 above. In this table, Above Obstacles (AO) is taken to mean height above the established height of the virtual clearway. The common use of 10 ft refers to the base of the avoid area of the HV envelope (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(iii) & (vii)).

Table 16: PC2WE summary of exposure

Open Areas <CAT A	Exposure starts	Exposure finishes
Take-Off	10 ft	40 KIAS (DPATO)
Landing	Committed at 40 KIAS & 80 ft AO but no exposure on a normal profile	
Ground Level or Elevated Helipad		
Vertical Take-off <CAT A	10 ft	130 ft AO (DPATO)
Vertical Take-off >CAT A	10 ft	40 KIAS + 35 ft AO (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 80 ft AO but no exposure on a normal profile	
Landing double-angle (above or below CAT A)	40 KIAS & 80 ft AO (DPBL)	at helipad
Elevated Helipad (on critical infrastructure)		
Take-off >CAT A	10 ft	40 KIAS achievable (DPATO)
Landing direct >CAT A	Committed at 40 KIAS & 80 ft AO but no exposure on a normal profile	

21 PC2WE Risk Assessments

21.1 Risk mitigation by CASA

21.1.1 CASA reviews the acceptability of an operator's PC2WE operations on the basis of compliance with the requirements of the Part 133 MOS, sections 10.11 to 10.16. These are summarised as:

- a maximum exposure time of 36 seconds, with anything above nine seconds supportable by engine power loss rates proportionally less than 1:100,000 hours
- having in excess of HOGE power margins
- all rotorcraft and engine preventative maintenance actions are completed
- risk assessment procedures for EC135 PC2WE operations are in place, including measures to mitigate the risk (refer to 21.2 below)
- operations are conducted in accordance with the RFM and this exposition
- flight crew training and checking is conducted to achieve competence in the flight procedures described in sections 18 to 20 of this Annex.

21.2 PC2WE risks and mitigation measures

21.2.1 This sub-section provides some, but not limiting, guidance to operators on the risks of operating PC2WE and possible mitigation measures. It is written on the assumption that an operator has achieved base-line compliance with the regulated control measures described above. This is meant as a start point to help operators integrate PC2WE risk assessments into their existing SMS risk register. Detailed risk statements, impacts, initial and residual risk levels should be determined in line with the operator's established risk assessment processes.

Table 17: PC2WE risks & possible mitigation measures

Risks	Mitigation measures
Pilot excessive focus on PC2WE compliance results in obstacle strike.	• Exposition and training briefs highlight obstacle strikes as the highest risk in helipad environments. • Obstacle avoidance techniques are prioritised above engine failure considerations and techniques, due to the relative risk levels. • The company allows variations from compliance with PC2WE considerations, in order to maintain overall safe operations, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system. • A second pilot or air crew member is available to assist into unknown landing sites, smaller than 25 m diameter, to mitigate the risk of obstacle strikes. • The pilot conducts a pre-departure review of the take-off path, likely obstacles, and determination of required performance to avoid obstacles in addition to PC2WE considerations.
Global fleet reliability reduces below the approved 1:100,000 engine power loss rate.	• Company aircraft have historical engine failure rates of 0.09 per 100,000 hours but apply a conservative rate of 0.25 per 100,000 hours. • Annual report has been obtained from Type Certificate Holder to state compliance with 1:100,000-hour engine failure rate target. • Company SMS tracks global accidents for company aircraft to establish early trends of engine failure rates.

Risks	Mitigation measures
Pilot techniques and / or environment require exposure periods greater than the exposure time limit	• The company can justify a 36-second exposure time limit based on power loss rates. • Use of 150 fpm as the minimum 40 KIAS OEI rate of climb as a maximum weight provides sufficient HOGE power margin to remain within exposure time limits. • Exceeding 36 seconds exposure is only approved for MT or ESO operations at an MT or ESO Operating Site. • Non-MT / ESO operations are conducted to less complex landing sites than for MT / ESOs. • Pilot simulator (if available) and line training in vertical and oblique take-off and landing techniques, including awareness of the time it takes to conduct these at PC2WE weight limits. • Pilots are trained not to delay the DPATO any later than necessary, and to nominate a DPBL that is as late as possible in the approach. • Pilot training in accurate assessment of aircraft height / speed energy to allow for a safe fly-away (in simulator if available).
Pilot PC2WE performance assessment, procedures or flying techniques are inadequate or not understood.	• Exposition has specific sections explaining PC2WE, what it is, and flying techniques to use. • Exposition describes pilot methods for determining obstacle gradients, and this is practiced in Line Training. • Training and checking is conducted in PC2WE techniques up to PC2WE weight limits (in simulator if available). • Co-pilot or Air Crew Member training in PC2WE requirements is provided so they can provide knowledge and procedural support for the pilot. • Variations from PC2WE are permitted, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system.
Pilot PC2WE performance procedures or flying techniques expose third party persons or things to unacceptable impacts of rotor downwash and outwash.	• Exposition procedures for ensuring the safety of people, animals, buildings and things during helicopter operations through the establishment of downwash/outwash protection safety distances for operations. • Liaison with regular use helicopter landing site and heliport operators regarding strategies for minimising the impacts of rotor downwash/outwash at these locations. For example, downwash/outwash protection zones. • Exposition procedures for crews to have operations specific awareness training on the size and effects of rotor downwash/outwash during PC2WE and other operations. • Initial and recurrent competency and proficiency assessments to ensure flight and other crew member awareness of the effects of rotor downwash/outwash during PC2WE and other operations. • Ground crew personnel trained in rotor downwash/outwash effects and safety procedures. • Exposition procedures to ensure operational crews conduct a pre-flight and in-flight operational risk assessment of potential rotor downwash/outwash effects.

Risks	Mitigation measures
The pilot training system is incomplete or ineffective.	• Company conversion training includes a specific long brief on helicopter performance and PC2WE operations. • Six-monthly simulator sessions conducted, including training and checking in PC2WE operations up to PC2WE weight limits (in simulator if available). • Co-pilots and Air Crew Members also participate in pilot simulator training for PC2WE operations. • Line Training provides opportunities to train pilots in the application of obstacle surveys and PC2WE requirements. • Pre-take-off and pre-landing briefings require mention to the crew of whether 'exposure' is present, or not. • Six-monthly training meetings review standardization and effectiveness of the training system.
The required engine / airframe preventative maintenance is not conducted.	• Aircraft maintenance is conducted in accordance with the CASA-approved CASR Part 145 Exposition, and company System of Maintenance. • The company follows the preventative maintenance requirements recommended and / or approved by the OEM. • Engine modifications are not conducted without approval of the engine and airframe Type Certificate holder. • The Company Quality Assurance program assesses compliance with the System of Maintenance through an audit program. • Engine and drive-train heavy maintenance is conducted by a CASA and OEM-approved overhaul facility.
Usage Monitoring System fails to record or operate correctly.	• Company OMEL requires a serviceable UMS for PC2WE operations. • UMS is maintained and data assessed as accurate in accordance with the CASA-approved CASR Part 145 Exposition, and Company System of Maintenance.

22 PC2WE operations A109E rotorcraft

22.1 Purpose of this section

22.1.1 The purpose of this section of the Annex is to provide an Acceptable Means of Compliance (AMC) for the preparation of a CASR Part 119 exposition or a CASR Part 138 operations manual for PC2 with exposure (PC2WE) operations in the A109E rotorcraft. It could also be used as a guide for operators using other A109 variants. Noting that PC2WE operations are not mandatory for Part 138 operations. This will allow an AOC or Aerial Work Certificate holder to satisfy CASA of the PC2WE regulatory requirement if they choose to use and follow this section of the Annex. However, they may also propose alternative means of compliance to the AMC proposed here if they so desire. This alternative means will need to be assessed and found acceptable for the purpose by CASA.

22.1.2 Operators and flight crew members should develop an understanding of the performance class system, as detailed within AC 133-01 Performance Class Operations (AC133-01) and AC 133-02 Performance Class 2 With Exposure Operations (AC133-02), prior to reading this Annex.

22.1.3 In addition to the sections in this Annex on PC2WE and if applicable to their operations, operators are required to detail the procedures for use during PC1, PC2 (without exposure) and PC3 operations in their exposition or operations manual. Guidance on what is required for these operations is contained within AC 133-01.

22.1.4 To maximise the benefit of PC2WE by keeping exposure times within limits, operators should encourage heliport operators to keep take-off and approach path obstacle-free gradients as low as possible. Failure to achieve this may mean PC2WE is not a viable option at that heliport.

22.1.5 The following sections 23 to 25 are written as AMC for direct transfer into company expositions or operations manuals for an A109E operator.

22.1.6 The policy of having no engine failure exposure risk from critical infrastructure is a limitation proposed by the example set out in the AMC of the Annex, however this is not a mandatory requirement for operators. Operators may propose alternative procedures to those suggested in sub-sections 25.6 and 25.7.

22.1.7 In addition to the AMC provided in this Annex, operators should consider providing pilots with simplified tables or an electronic method for determining the required performance data so as to avoid potential error with using RFM charts.

22.1.8 Section 26 provides some guidance on how to develop the risk assessment for PC2WE operations.

22.1.9 In this document, reference is made to the Part 133 MOS; however, such referencing is not considered mandatory for an exposition or operations manual, with an expectation that referencing AC133-01 and AC133-02 (as applicable) will be sufficient for pilots.

23 Policy for A109E PC2WE operations

23.1 Background

23.1.1 For maintenance of appropriate operational capability, the company has a requirement to conduct PC2WE operations.

23.1.2 Company approval to conduct PC2WE operations is predicated upon achieving CASA requirements for:

- a target level of safety
- engine reliability assessment
- continuing engine reliability assurance
- mitigating airworthiness procedures, and
- mitigating operational procedures and training (refer to CASA AC 133-02, section 3).

23.1.3 As part of the CASA approval process for PC2WE operations, the company has also completed an Operational Risk Assessment for PC2WE operations. This can be referenced at (insert company manual reference).

23.1.4 PC2WE can allow greater operational flexibility for operations at higher weights to and from heliports with more complex obstacle environments.

23.1.5 To maintain PC2WE safety risk at an appropriate level, CASA AC 133-02 provides guidance to operators and pilots in how to risk manage such operations. For a deeper understanding of PC2WE operations, company pilots should become familiar with CASA AC 133-02.

23.1.6 A109E performance figures used are based on an aircraft equipped with P&W206C powerplants. It is assumed to be fitted without any external optional equipment (which give performance penalties) and to have no heater, EAPS or ECS operative during take-off or landing procedures. Pilots must note that configurations that vary from that described above will require different performance figures to what is mentioned in these sections.

23.1.7 Performance data is drawn from the basic RFM and Appendix 12 for Equivalent Category A Operations - Clear Area; Short Field; Ground Based or Elevated Helipad.

23.1.8 The company Training Manual details the additional flight crew training and checking requirements for the procedures described within this section. Before using PC2WE in line operations company flight crew members must complete and been found competent in accordance with the training and checking manual PC2WE requirements outlined therein.

23.1.9 Although PC1 and PC2 operations should be conducted wherever operationally possible, PC2WE is the minimum standard for the following types of A109E operation (refer regulation 133.335 of the CASR):

- passenger transport operations under night VFR or IFR
- medical transport operations (compliance with a performance class is not mandatory at a Medical Transport Operating Site (regulation 133.315), provided such operations are conducted in accordance with this exposition). The main utility for PC2WE in Medical Transport operations will be to / from hospital heliports where Category A limits and procedures cannot be applied.

23.2 A109E relevant characteristics and assumptions

23.2.1 The overall length (D-value) for the A109E is 13.1 m. This is relevant for the dimensions of the heliport FATO and Safety Area. A heliport of insufficient size to meet PC2 requires PC2WE operations.

23.2.2 The rotor radius (R) for the A109E is 5.5 m. This is applicable for defining the area to survey beyond DPATO for take-off path obstacles.

23.2.3 Because PC2WE operations do not mandate the use of Category A procedures, targeted selection of the different Category A procedures and associated performance are used by the company to achieve PC2WE compliance. From these, the following assumptions may be made for the company operating environment, and they are summarised in Table 18 below:

- For any Category A Clear Area ‘soft’ take-off procedure, the worst-case rejected take-off distance required is 400 m. Available distances less than this will require PC2WE.
- For any RFM Category A Clear Area (‘soft’) or Helipad take-off procedure, 130 m is the worst-case OEI take-off distance required (based on a 150 ft TDP). The 130 m may either be available horizontally directly from the take-off point, or it can be created as a virtual clearway from a raised incline plane (refer to AC 133-01, sections 6.4 and 6.5).
- For any RFM Category A Clear Area or Helipad landing procedure, 370 m is the worst-case OEI baulked landing distance required. The 370 m may either be horizontally direct from the helipad, or it can be established as a virtual clearway creating a raised incline plane for the OLS (see AC 133-01, sections 6.4 and 6.5).
- For any CAT A Clear Area landing procedure, 90 m is the worst-case OEI landing distance required.
- For any type of Category A landing below the respective CAT A weight limits, OEI height loss from LDP is 45 ft.
- For any Helipad take-off when below the CAT A weight limit, the OEI worst-case height loss from any TDP up to 300 ft is 115 ft. PC2WE operations are not permitted if the TDP or LDP for the procedure is required to be any higher than 300 ft above the heliport (refer to Part 133 MOS, section 10.06).

Table 18: A109E standard performance figures

Scenario	Standard figure
CAT A Clear Area worst-case rejected take-off distance required (RFM Appendix 12, page 68)	400 m
CAT A worst-case take-off distance required (RFM Appendix 12, pages 68 & 70)	130 m
CAT A worst-case baulked landing distance required (RFM Appendix 12, page 68)	370 m
CAT A Clear Area worst-case landing distance required (RFM Appendix 12, page 68)	90 m
Height loss from any CAT A LDP	45 ft
Worst-case height loss from CAT A Helipad TDP (RFM Appendix 12, page 34B)	115 ft

23.3 Maximum permitted exposure time

AMC for Part 133 MOS, section 10.11.

23.3.1 Current engine reliability data from Leonardo Helicopter Division for the A109E allows approved rotorcraft a maximum permitted exposure time of 36 seconds, based on it meeting or exceeding an engine power loss rate of 0.25:100,000 hours.

23.3.2 Pilots are to ensure that the take-off and landing techniques used for PC2WE require no more than 36 seconds of exposure. If this is not possible, the PIC must take steps to reduce weight and / or adopt alternative techniques such that the maximum exposure time is not exceeded.

23.4 PC2WE limitations & performance charts

AMC for Part 133 MOS, section 10.12.

23.4.1 This sub-section details company operating limitations and relevant performance charts for PC2WE, including those for determining take-off weight limitations to meet the requirements of section 10.12 of the Part 133 MOS. The company will provide pilots with extracts of the relevant charts (or tabulated / computerised data), as per Table 19 below, for determination of PC2WE performance.

Table 19: RFM performance chart reference

Limitation	Reference chart
CAT A Clear Area Weight-Altitude-Temperature Limit	RFM Appendix 12, Figures 1-1
2.5% (150 fpm) OEI gradient to 1,000 ft using MCP at 60 KIAS	RFM Appendix 12, Figures 4-11
If over populous areas - 8.0% (240 fpm) OEI gradient at 30 KIAS	RFM Appendix 12, Figures 4-6
50 fpm OEI ROC at MCP and 60 KIAS	Basic RFM, Figures 4-22 (2,850 kg)

23.4.2 The Category A Short Field and Helipad weight-altitude-temperature limitation charts are not included for discussion in this section as they are more specifically applicable to PC1 and PC2 operations. However, operations within these CAT A weight limits will help to reduce the exposure risk.

23.4.3 There is a requirement of PC2WE to ensure there is sufficient HOGE performance to conduct a departure and approach from / to a hover OGE. This is achieved by limiting PC2WE weights to the CAT A Clear Area weight limit, which is also well within the HOGE weight limit.

For example, at 31° C & 1,000 ft the CAT A Clear Area weight limit is 2,850 kg.

23.4.4 Pilots must ensure that, for PC2WE operations, the aircraft weight at take-off or landing is no greater than that required to achieve an OEI rate of climb of 150 fpm (equates to 2.5% at 60 KIAS) at 1,000 ft above the heliport. In these calculations, wind benefit must not be applied. This is achieved by remaining within the CAT A Clear Area weight limits described above.

For example, for a take-off at 2,850 kg, 31° C & 1,000 ft, a 60 KIAS OEI climb gives 4.5% (270 fpm).

23.4.5 To provide additional OEI power margins and reduce risk over populous areas, pilots must also ensure that, for company PC2WE operations over populous areas, the aircraft weight at take-off or landing is no greater than that required to achieve a 30 KIAS OEI rate of climb at 2.5-min power of 8.0%. In these calculations, wind benefit must not be applied.

For example, at 2,850 kg and 1,000 ft this makes the limiting temperature 30°C, whereas outside of populous areas it would be limited by the CAT A Clear Area weight limit (refer to CASA AC 133-02, section 2.9.2).

Note: AC 133-02, section 2.9.2, indicates that 8.0% is not mandatory; however, the company has incorporated this into the standard operating procedures as a safety enhancement.

23.4.6 Pilots must ensure that, once above the lower of DPATO / DPBL or 300 ft, the OEI gradient of climb is greater than or equal to the take-off path obstacle-free gradient (also known as the Obstacle Limiting Surface (OLS) gradient). OLS gradients for commonly used heliports are indicated in the company helipad register. Otherwise, they should be calculated as described in sub-section 24.3 below.

23.4.7 As for PC1 and PC2, the OEI rate of climb at the minimum altitude must be at least 50 fpm. The minimum altitude for Day VFR and NVIS flight is 1,000 ft, and for night unaided or IFR flight is LSALT or MSA.

For example, 50 fpm OEI rate of climb is achievable up to 2,850 kg and 25°C at 6,000 ft.

23.4.8 If wishing to conduct PC2 operations from a clear area, pilots must confirm that the available smooth, level, hard surface suitable for a rejected take-off is greater than the worst-case 400 m rejected take-off distance required. If the available distance is less than 400 m, PC2WE is required.

23.4.9 If operating from elevated heliports and helidecks built on top of critical infrastructure or occupied buildings, pilots must not, for any take-off, accept an engine failure exposure risk that involves rejecting back to the building after entry into the avoid area of the HV envelope (20ft). This means a rejected take-off to the heliport or helideck must not be conducted unless within the CAT A Helipad weight limits.

23.5 Suitable Forced Landing Area

23.5.1 Exposure can be avoided if usable reject or OEI landing areas can be classified as a suitable forced landing area. The area can be considered suitable if it meets the requirements for a PC2 heliport as discussed in sub-section 24.1 below, and which also equates to the RFM ‘smooth, level and hard surface’ as discussed under the height-velocity section of the RFM. Pilots must assess potential suitable forced landing areas by referencing the company heliport register for a known location, or on the basis of the guidance in CASA AC 133-01, section 4.1.

23.5.2 Water landing areas, when assessed as suitable by the company SMS, can also be considered as suitable forced landing areas for the A109E. The aircraft must be fitted with an approved emergency flotation system and operated in not greater than sea state 4 conditions (certification requirement). However, there must also be a reasonable expectation of rescue within survival times, and the operations must be in areas where search and rescue capabilities are available. For the purpose of this requirement, the company defines the boundaries of areas where SAR capability is available at (insert company manual reference) of this exposition.

23.5.3 Regardless of the quality of the forced landing area, it is not considered suitable for PC2 operations if an attempted OEI landing is made from inside the avoid area of the HV envelope, unless below the applicable CAT A Helipad weight limits, or during a normal angle approach. Likewise, for an area to be suitable during a clear area rejected take-off, the smooth, level and hard surface available (runway plus possible stopway) must exceed the RFM rejected take-off distance required. In the A109E, it can be up to 400 m, so pilots must have an awareness of this distance, particularly from very short areas, to be able to determine the need for PC2WE and alternative techniques.

23.6 Height-Velocity limitations

AMC for Part 133 MOS, section 2.02.

23.6.1 PC2WE operations are not required if entry into the avoid area of the HV envelope is part of:

- a take-off, landing, or hover (including winching) operation at a medical transport operating site
- winch operations with OEI HOGE performance, or
- when operating within RFM CAT A limitations and procedures (this would be PC2 at least).

23.6.2 Other than as mentioned above, any operational requirement to enter the avoid area of the HV envelope during take-off will require pilots to ensure PC2WE requirements can be met, even if a suitable forced landing area is available.

23.6.3 For the A109E operating at the weight limits associated with PC2WE, pilots can assume they are outside of the avoid area if below 20 ft and faster than 15 KIAS.

23.6.4 Operations outside the avoid area of the HV envelope will still require PC2WE operations if a suitable forced landing area is not available, or if a safe OEI flyway is not possible.

23.7 Adequate Vertical Margin

AMC for Part 133 MOS, section 10.02 & 10.30.

23.7.1 As part of the PC2WE requirements, prior to DPATO and after DPBL, pilots must fly the aircraft to avoid all obstacles by at least an adequate vertical margin.

23.7.2 The company defines 10 ft (3.0 m) as an adequate vertical margin for the A109E. However, under the following circumstances pilots must use at least 15 ft (4.5 m) as an adequate vertical margin:

- when the physical nature of the obstacles makes depth perception difficult
- when visibility is degraded due to precipitation, bright lights, or windshield obscurants
- at the pilot’s discretion.

24 A109E Survey Procedures

AMC for Part 133 MOS, subsection 10.32(6).

24.1 Instructions for heliport survey

24.1.1 PC2WE operations could mean exposure to an OEI landing risk on a sub-standard reject area, and / or exposure to a flyaway risk. Pilots are to determine whether the proposed OEI reject area requires PC2WE.

24.1.2 Except in the case of extreme surface conditions, such as swamp, marshland or heavily ploughed fields, surface strength of ground level areas never requires PC2WE, provided the size and slope are within the limits mentioned below. PC2WE operations to elevated heliports / helidecks must not be conducted above the stated weight limits for those structures.

24.1.3 PC2WE is required for any rejected take-off or OEI landing area if:

- the diameter of area is less than 26.2 m. This may be measured through use of mapping applications by pacing the area, or if an airborne assessment may be based on pilot judgement and comparison with known area sizes
- using a CAT A Clear Area take-off profile the reject distance available is less than the reject distance required (refer to sub-section 23.5.3 above)
- the mean slope of the area is greater than 5°.

24.2 Instructions for obstacle survey

24.2.1 Pilots are permitted to conduct airborne or ground surveys of PC2 and PC2WE take-off and approach paths for determination of relevant obstacles in accordance with this sub-section (refer to Part 133 MOS, section 10.32(6)).

24.2.2 Surveys of certified or registered instrument runways are not required, but prior to using these runways, pilots must access the OLS gradient and Accelerate Stop Distance Available (ASDA) from the ERSA Runway Distance Supplement (ASDA is the same as rejected take-off distance available and includes the runway length plus stopway).

24.2.3 Due to the complexity of conducting a pilot survey, where possible, pilots are to take advantage of existing heliport obstacle survey information provided in AirServices Australia documentation, or in the company heliport register for commonly used heliports. These surveys are normally compliant with a 4.5% OLS gradient from the edge of the FATO to 500 ft, within a 9° (15%) splay left and right of the FATO edge.

24.2.4 Survey information received on the same day from other company pilots may be used, provided their use of the heliport was in the last 12 months.

24.2.5 Pilot surveys must only be conducted by day or at night using NVIS.

24.2.6 As discussed in sub-section 23.2.3 above, 130 m is the worst-case take-off distance required when within the CAT A Clear Area weight limits (PC2WE limiting weight). This means that following an engine failure, it could take up 130 m before the aircraft commences a climb. For this reason, a virtual clearway should be established extending 130 m from the FATO. From that point an OLS gradient can be established. However, if conducting a helipad take-off profile, and obstacles are present within the first 130 m, the virtual clearway must also be raised to the level of those obstacles creating a raised incline plane for the OLS. This ensures that from a TDP or rotate point, the OEI height loss still remains 35 ft (10.7 m) above the obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii) and to CASA AC 133-01, section 6.4.2).

24.2.7 For an approach, the worst-case baulked landing distance is 370 m, if conducting an approach, the virtual clearway and origin of the OLS gradient must be extended out 370 m from the FATO.

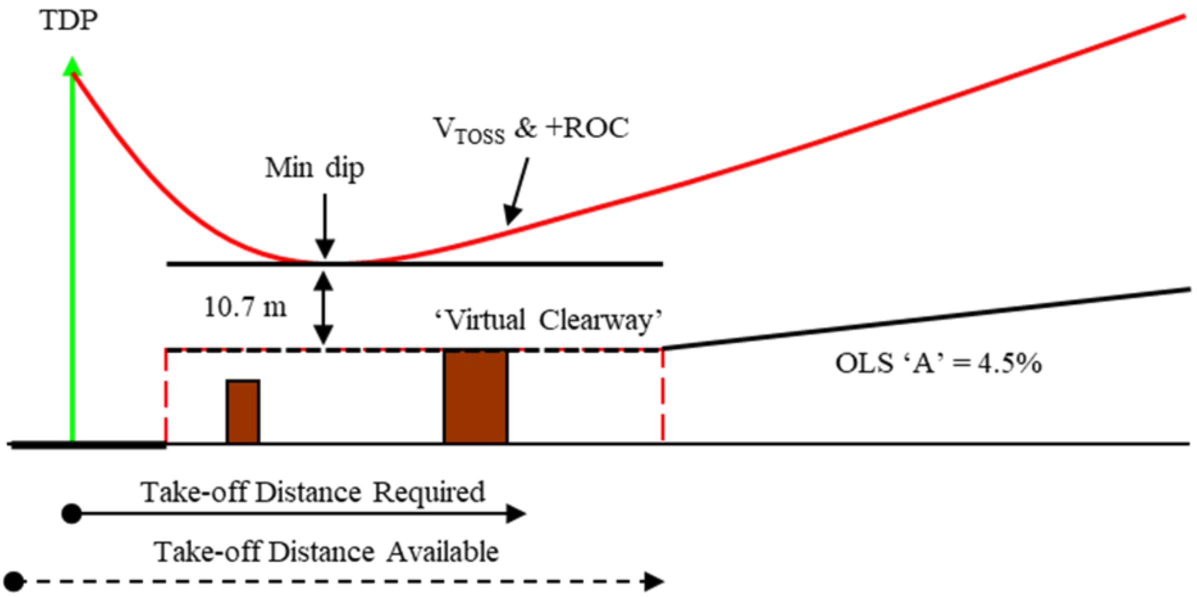

Figure 29: Raised virtual clearway

24.2.8 For company operations, pilots must assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 6.5 km. Noting that turns are permitted to avoid obstacles once at 200 ft above obstacles by day or on NVIS, or above 500 ft by night unaided, the unavoidable obstacle creating the steepest gradient within this area will be the limiting obstacle. If obstacles at the splay edges are of concern, the splay can be limited to a width of 55 m either side of the take-off path.

24.2.9 Determine the OLS gradient to the limiting obstacle by estimating the height above the raised incline plane and distance from the end of the virtual clearway. Mapping applications may be used to assist, but pilots may also estimate heights based on obstacle heights of familiar features such as domestic power poles (10 m).

OLS gradient = 100 x (height of obstacle above raised incline plane) /

(distance to obstacle from end of virtual clearway)

Note: It is acknowledged that the limiting obstacle may not be visible from the helipad due to obstructions in the immediate vicinity. However, it is acceptable for a pilot to use their judgement of heights and distances based on the nature of local vegetation and terrain, and information obtained from mapping applications.

24.2.10 If the calculated OLS gradient exceeds the aircraft's OEI climb gradient to 1,000 ft, the pilot must either plan to conduct a turn back to overhead before reaching the critical obstacle or reduce the OLS gradient by further elevating the raised incline plane.

For example, an obstacle 60 m (200 ft) above the raised incline plane, and 500 m from the end of the virtual clearway produces a gradient of 12%. However, if the incline plane is raised by a further 30 m (100 ft), the new calculation would be 100 x 30 / 500 = 6%, which may be achievable by the aircraft. As mentioned earlier, any raising of the incline plane and virtual clearway will also require an upwards correction of the TDP or rotate point for any helipad take-off (refer to Part 133 MOS, paragraph 10.12(d)).

24.3 Summary of PC2WE survey requirements

AMC for Part 133 MOS, paragraph 10.28(3)(b).

24.3.1 Helipad diameter must be greater than 26.2 m and slope less than 5° if wishing to avoid exposure during any rejected take-off or OEI landing.

24.3.2 Assess an area within a 10° splay left and right of the FATO edge out to any limiting obstacle, or a maximum of 6.5 km.

24.3.3 Identify the highest obstacle in the splay above or below the helipad, within 130 m for take-offs or within 370 m for approaches. This equates to the height of the virtual clearway.

Note: Temporary obstacles, such as cranes and other temporary structures, also need to be considered.

24.3.4 Within the splay, assess the height and distance of the limiting obstacle relative to the end of the virtual clearway.

24.3.5 Calculate the OLS gradient to the limiting obstacle from the end of the virtual clearway and ensure this is less than the aircraft OEI climb gradient to 1,000 ft (refer to Part 133 MOS, paragraph 10.12(d)).

24.3.6 Adjust the rotate point or TDP to ensure 35 ft clearance from the height of the virtual clearway (refer to Part 133 MOS, subparagraph 10.28(3)(c)(ii)).

24.4 Use of an error budget

24.4.1 Because PC2WE involves various performance calculations, plus pilot visual assessments of dimensions, slopes, heights and distances, all of which are prone to error, it is prudent to ensure there are tolerances for error. The company has the following control measures in place to ensure an appropriate margin of error is available:

- A maximum weight as provided by the CAT A Clear Area weight limits (maximum 2,850 kg).
- PC2WE must not be conducted for approaches to obstructed helipads unless a CAT A Clear Area approach angle can be flown to a point in space above the helipad (double-angle).
- Wind benefit must not to be considered for PC2WE performance calculations as this can be unreliable and adds complexity to the gathering of performance data.
- The use of a worst-case 130 m take-off distance and 370 m baulked landing distance is normally in excess of what is actually required.
- The use of an assumed 0.25:100,000-hour engine power loss rate is higher than the reported rate.

25 Flight Procedures

25.1 Take-off and landing common calculations

25.1.1 The following information must be determined prior to all take-offs and landings for the expected weights, altitude and temperature of operations. This may be done on a worst-case basis of weights, altitudes and temperatures to cover multiple take-offs and landings (refer to Part 133 MOS, paragraph 10.28(3)(a)):

- Confirm if the aircraft weight and / or obstacle environment allows the use of CAT A Helipad techniques to meet PC2.
- Determine the CAT A Clear Area limiting weight (maximum 2,850 kg).
- For the take-off and baulked landing flight paths, determine the OEI climb gradient at 60 KIAS, MCP and 1,000 ft (refer to Part 133 MOS, paragraph 10.12(c), subparagraph 10.12 (f)(i) and subparagraphs 10.28(3)(c)(ii) & (vi)).
- If over populous areas, confirm the OEI climb gradient at 30 KIAS and 2.5-min power is at least 8.0%.
- Conduct the take-off path survey as per sub-section 24.3 above. If turns are not planned until after the critical obstacle, ensure the OLS gradient is less than the 60 KIAS OEI climb gradient.
- Identify visually, and / or with maps, the optimal flight path to follow if OEI after DPATO or before DPBL, but only allow for turns once above 200 ft (500 ft if night unaided) (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(i) & (v)).
- Determine OEI rate of climb at 60 KIAS and MCP, at 1,000 ft AGL for Day VFR or NVIS, otherwise at LSALT, is at least 50 fpm (Part 133 MOS, paragraph 10.12(e) and subparagraph 10.28(3)(c)(iv)).

25.2 Take-off from open areas unsuitable for a rejected take-off

25.2.1 This procedure could be used from treeless paddocks or open fields that are unsuitable for a rejected take-off. This sub-section assumes the immediate lift-off area is of a suitable size and slope for a forced landing.

25.2.2 Despite having the option of conducting this open area procedure, pilots should alternatively use the helipad procedures described later in this section if they assess the relative risk and the consequences of a rejected take-off will be lessened, even if this means a slightly higher exposure time.

25.2.3 Conduct the take-off using the CAT A Clear Area ‘soft take-off’ procedure. If the virtual clearway is raised, conduct the initial take-off vertically, using up to take-off power, until 35 ft above the virtual clearway height (to a maximum of 300 ft above the heliport), then rotate to fly the ‘soft take-off’ procedure. Exposure commences from entry into any HV avoid area (20 ft) and finishes at 30 KIAS & 70 ft above the virtual clearway (DPATO) (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

25.2.4 If OEI after the DPATO, continue with the CAT A Clear Area OEI procedure and, if necessary, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles by at least 50 ft and climb to a safe height. Pilots should maintain an awareness of the loss of climb performance during turns.

25.2.5 If OEI before the DPATO, conduct the rejected take-off procedure to land in the safest area available with minimum speed for the surface conditions.

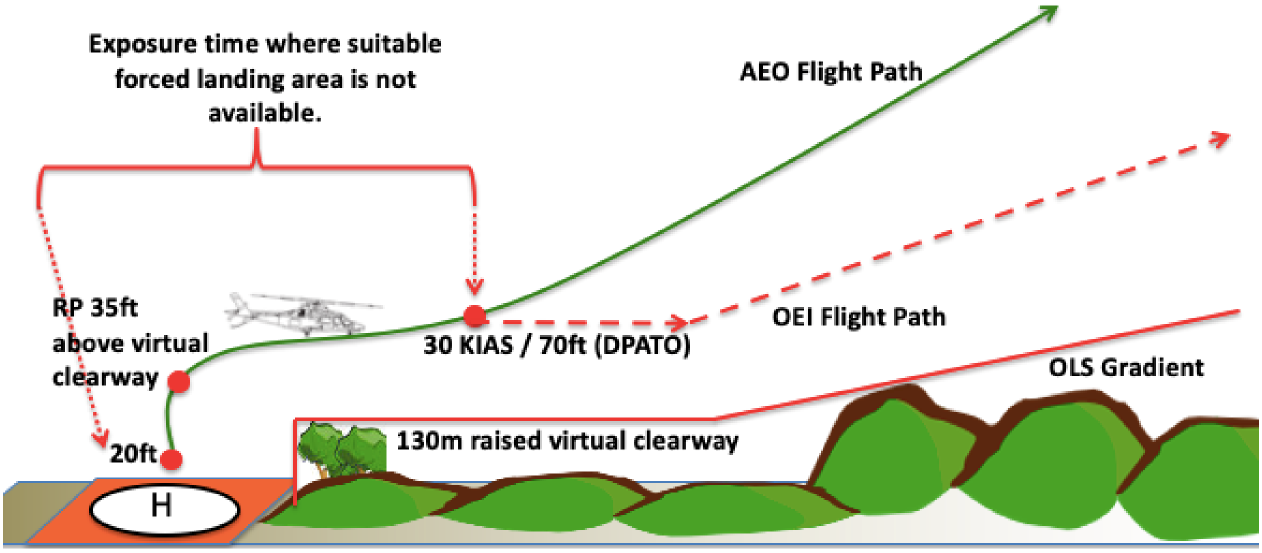

Figure 30: PC2WE open area take-off

25.3 Approach to open areas unsuitable for a run-on landing

25.3.1 This sub-section assumes that obstacles on the approach will allow the CAT A Clear Area profile to be flown. If not, apply the procedures for a helipad as discussed later in this section.

25.3.2 If a direct approach is possible, no exposure should be present under the PC2WE regime to a suitable helipad. With the available HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. For the clear area profile, pilots should use 25 KIAS and 80 ft above the virtual clearway as the basis for when they are 'committed' to an OEI landing and can no longer achieve a safe baulked landing (Figure 31 below).

Note: The assumption is that the approach will allow AEO power required to remain below 71% TQ (equivalent to 142% OEI TQ) and so always allow the helipad to be reached.

25.3.3 If OEI before the committal point (DPBL), conduct the CAT A Clear Area baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

25.3.4 If OEI after the committal point, continue the approach to land at the helipad with minimum speed for the surface conditions.

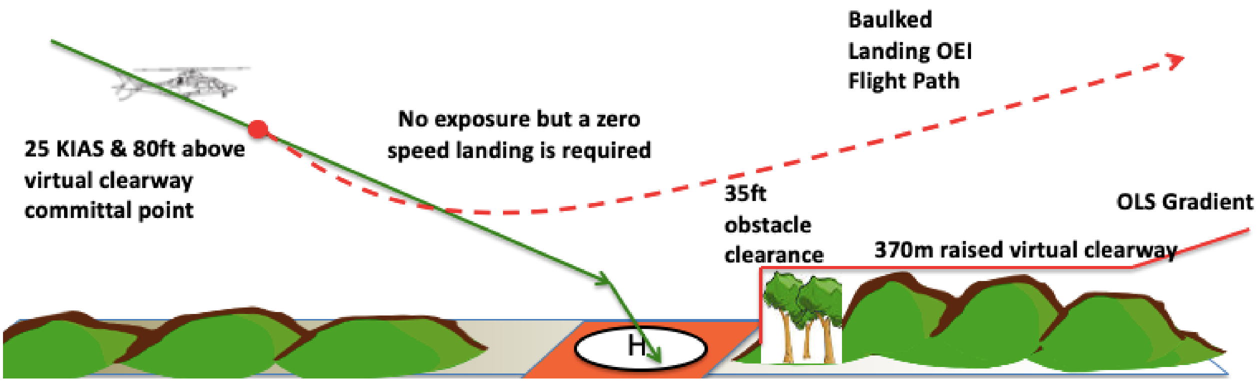

Figure 31: PC2WE open area approach

25.4 PC2WE take-offs from heliports / helidecks

25.4.1 This sub-section assumes the FATO meets the dimensions and slope requirements for a suitable forced landing area.

25.4.2 These helipads are assumed not to be on top of critical infrastructure but provide a surrounding visual cuing environment sufficient for pilot reference to be maintained during extended vertical take-offs.

25.4.3 Confirm the helipad allows for the CAT A Helipad back-up procedure to be conducted. This means that, to retain an appropriate obstacle clearance for a reject, there must be no obstacles within a 10° splay higher than a 24° slope, from 23 m rear of the take-off point, back to 240 m. If obstacles are present and do not allow this procedure, the vertical procedures described later in this sub-section must be applied instead.

> **Note:** The maximum back-up distance of 240 m is based on using the maximum TDP or rotate point of 300 ft.

25.4.4 Conduct the take-off using the CAT A Helipad procedure. If the virtual clearway is raised, the Rotate Point (RP) and DPATO must be achievable by 300 ft above the helipad, and:

- **If below CAT A Helipad weights**: TDP at 150 ft above the virtual clearway there is no exposure (PC2).
- **If below CAT A Helipad weights but unable to back-up (Figure 32)**: Conduct a vertical take-off using up to take-off power and rotate at 150 ft above the virtual clearway. Exposure will be from 20 ft until the RP. Maximum permitted virtual clearway height is 150 ft (300 ft RP).
- **If above CAT A weights (Figure 33)**: Conduct a vertical or back-up take-off using up to take-off power, and from 35 ft above the virtual clearway rotate to accelerate horizontally. Exposure will be from 20 ft until 30 KIAS & 70 ft above the virtual clearway (DPATO). Maximum permitted virtual clearway height is 230 ft (300 ft RP) (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

25.4.5 In some circumstances when above CAT A weights (Figure 33 below), the consequence of a rejected take-off after the RP could create a higher risk than continuing a vertical profile. However, because there is no data on OEI height loss at such weights, pilots must accept the exposure risk of OEI after the RP as shown in Figure 33 below.

25.4.6 If OEI after the DPATO, accelerate to 60 KIAS and, once at 200 ft (or 500 ft by night unaided), turn to avoid obstacles as necessary and climb to a safe height.

25.4.7 If OEI before the DPATO, reject the take-off to land back at the helipad, or reject the take-off to land in the safest area available with minimum speed for the surface conditions.

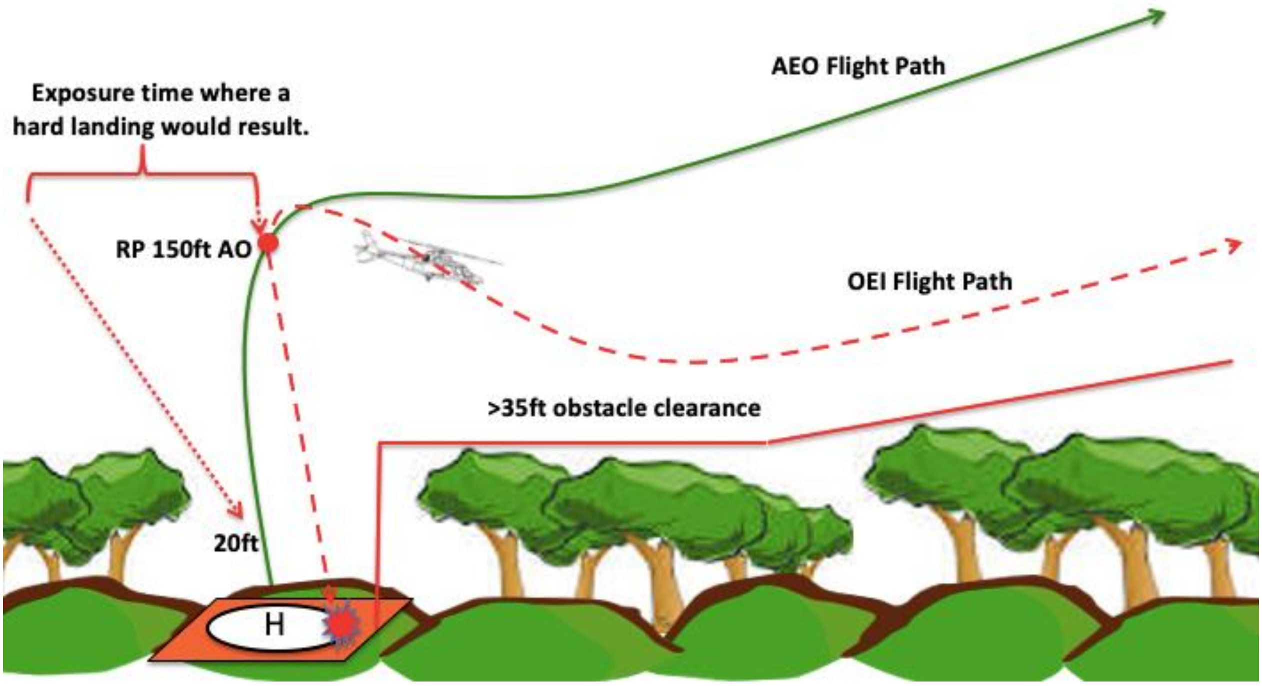

Figure 32: PC2WE Vertical take-off <CAT A

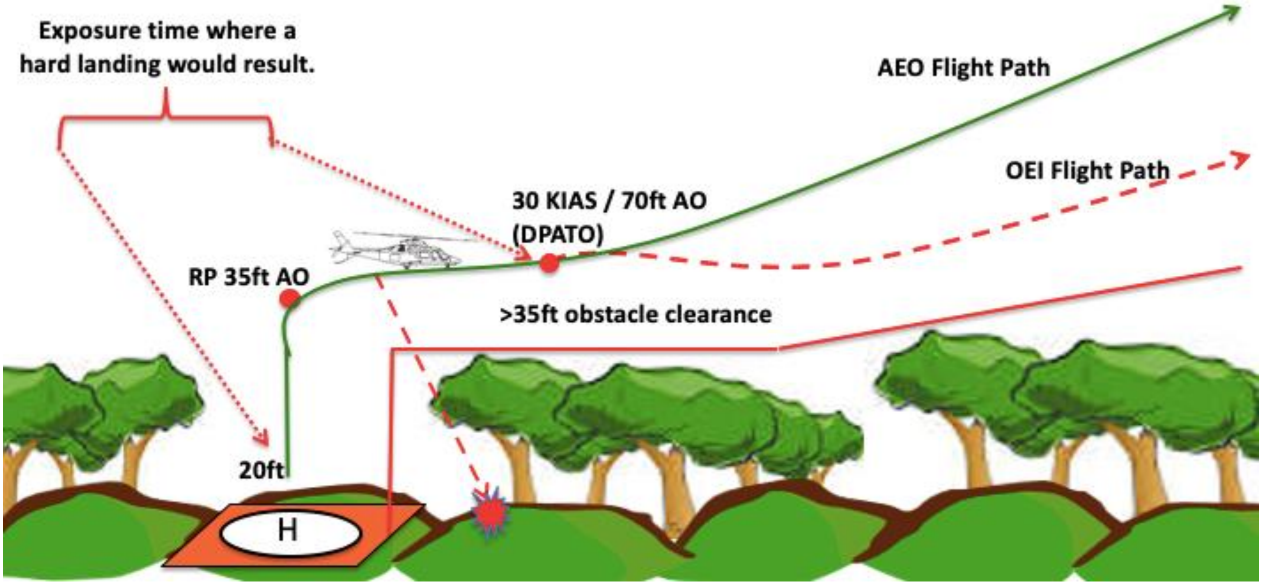

Figure 33: PC2WE Vertical take-off >CAT A

25.5 PC2WE approaches to heliports / helidecks

25.5.1 This sub-section can apply to heliports where obstacles allow a direct CAT A Clear Area approach profile to a ground level or elevated heliport / helideck, or where the obstacles do not allow the clear area approach profile. The difference is that, if obstacles are present, the approach will become a double-angle approach.

25.5.2 If a direct helipad approach is possible and within the CAT A Helipad weight limits and procedures, PC2WE is not required as this would be PC2.

25.5.3 If a direct helipad approach is possible, but above the CAT A Helipad weight limit, no exposure should be present under the PC2WE regime. With the required HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown on a suitable area. However, pilots must use 25 KIAS and 80 ft above the virtual clearway as the basis for when they are 'committed' to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the normal approach angle will allow AEO power required to remain below 71% TQ and so always allow the helipad to be reached.

25.5.4 If a double-angle approach is required **aircraft weight must be below the CAT A Clear Area weight limits**. In such situations fly the CAT A Clear Area approach profile to a double-angle. Exposure commences at 25 KIAS and 80 ft above any virtual clearway, and it finishes at the helipad (Figure 34 below). However, double-angle approaches are not ideal for PC2WE operations due to the potential for excessive exposure times. For this reason, **pilots must not conduct this approach if obstacles in the baulked landing flight path require a virtual clearway higher than 100 ft** (based on a 300 fpm rate of descent from a 180 ft DPBL).

25.5.5 If OEI before the DPBL, conduct the CAT A Clear Area baulked landing and, once at 200 ft (or 500 ft), turn to avoid obstacles as necessary and climb to a safe height.

25.5.6 If OEI after the DPBL, the profile should allow continuation of the double-angle approach for a descent into the helipad to land with minimum speed for the surface conditions.

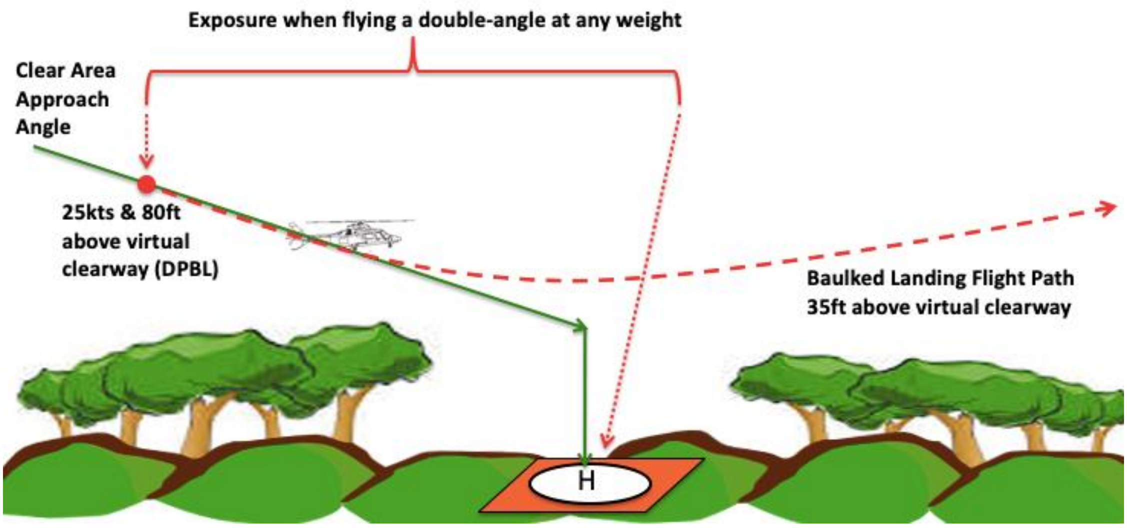

Figure 34: PC2WE obstructed helipad approach

25.6 PC2WE take-offs from elevated heliports / helidecks on critical infrastructure

25.6.1 This sub-section gives an option of lowering or raising the virtual clearway if supported by the pilot survey.

25.6.2 **If applying CAT A Helipad weights & procedures**: There is no exposure (PC2) if using a RP 150 ft above the virtual clearway.

25.6.3 **If above CAT A weights**: This is the most critical PC2WE situation for elevated helidecks on top of critical infrastructure in populous areas, where a reject back to the helideck may not be an acceptable risk (Figure 35 below):

- Review areas in the take-off path as possible emergency landing areas.
- To minimise risk of a deck-edge strike, commence the take-off from a point with the rotor disc at the front edge of the helideck.
- Apply up to take-off power and rotate for take-off at 20 ft. DPATO is located where the pilot judges 30 KIAS, 70 ft above the virtual clearway, and a positive climb 35 ft clear of obstacles can be achieved OEI. The exposure risk is from 20 ft until DPATO. Pilot judgement of DPATO will be based on their awareness of aircraft height loss performance, acceleration rates and height above obstacles (refer to Part 133 MOS, subparagraph 10.28(3)(e)(ii)).

25.6.4 If OEI after the DPATO, accelerate initially to 30 KIAS to commence a climb and, once at 200 ft (or 500 ft by night unaided), accelerate to 60 KIAS, then turn to avoid obstacles as necessary and climb to a safe height.

25.6.5 If OEI before the DPATO and prior to rotate, reject the take-off to land back at the helipad. If OEI before DPATO, but after the 20 ft RP, attempt to land with minimum speed at the pre-identified emergency landing areas ahead.

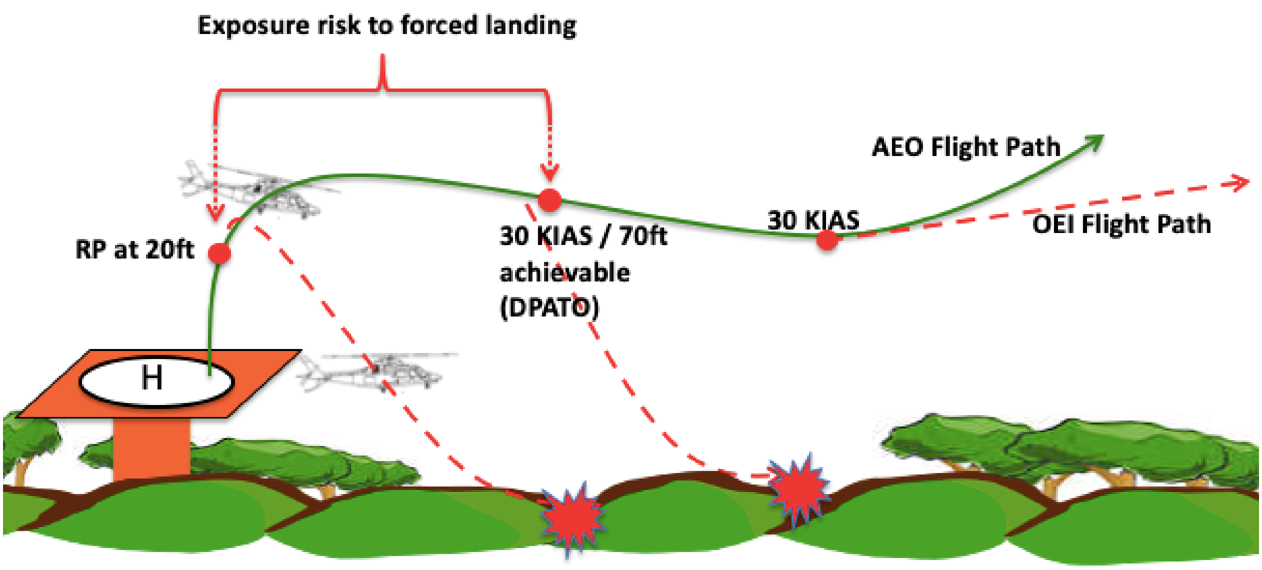

Figure 35: PC2WE Helideck take-off >CAT A

25.7 PC2WE approaches to elevated heliports / helidecks on critical infrastructure

25.7.1 Approaches to elevated heliports and helidecks on critical infrastructure must not be conducted unless a direct helipad approach angle, without a double angle, is possible. This removes the risk of a near vertical descent and engine power loss leading to an excessively heavy landing.

25.7.2 If conducting a direct helipad approach and within the CAT A Helipad weight limits, PC2WE is not required as this would be PC2.

25.7.3 If conducting a direct approach, but above the CAT A Helipad weight limit, no exposure should be present under the PC2WE regime for the approach. With the required HOGE power margins and provided a normal approach angle is flown, there is an expectation that any engine power loss can be carried through the avoid area of the HV envelope to touchdown. However, pilots must use 25 KIAS and 80 ft above the virtual clearway as the basis for when they are committed to an OEI landing and can no longer achieve a safe baulked landing.

Note: The assumption is that the normal approach angle will allow AEO power required to remain below 71% TQ and so always allow the helipad to be reached.

25.8 Summary of PC2WE DPATO & DPBL

25.8.1 Table 20 below summarises the numbers discussed in sub-sections 25.2 to 25.7 above. In this table, Above Obstacles (AO) is taken to mean height above the established height of the virtual clearway. The common use of 20 ft refers to the base of the avoid area of the HV envelope (refer to Part 133 MOS, subparagraphs 10.28(3)(c)(iii) & (vii)).

Table 20: PC2WE summary of exposure

Open Areas <CAT A	Exposure starts	Exposure finishes
Take-Off	20 ft	30 KIAS (DPATO)
Landing	Committed at 25 KIAS & 80 ft AO but no exposure on a normal profile	
Ground Level or Elevated Helipad		
Vertical Take-off <CAT A	20 ft	150 ft AO (DPATO)
Vertical Take-off >CAT A	20 ft	30 KIAS + 70 ft AO (DPATO)
Landing direct >CAT A	Committed at 25 KIAS & 80 ft AO but no exposure on a normal profile	
Landing double-angle (above or below CAT A)	25 KIAS & 80 ft AO (DPBL)	at helipad
Elevated Helipad (on critical infrastructure)		
Take-off >CAT A	20 ft	30 KIAS & 70 ft AO achievable (DPATO)
Landing direct >CAT A	Committed at 25 KIAS & 80 ft AO but no exposure on a normal profile	

26 PC2WE Risk Assessments

26.1 Risk mitigation by CASA

26.1.1 CASA reviews the acceptability of an operator's PC2WE operations on the basis of compliance with the requirements of the Part 133 MOS, sections 10.11 to 10.16. These are summarised as:

- a maximum exposure time of 36 seconds, with anything above nine seconds supportable by engine power loss rates that are proportionally less than 1:100,000 hours
- having in excess of HOGE power margins
- all rotorcraft and engine preventative maintenance actions are completed
- risk assessment procedures for A109E PC2WE operations are in place, including measures to mitigate the risk (refer to 26.2 below)
- operations are conducted in accordance with the RFM and this exposition
- flight crew training and checking is conducted in order to achieve competence in the flight procedures described in sections 23 to 25 of this Annex.

26.2 PC2WE risks and mitigation measures

26.2.1 This sub-section provides some, but not limiting, guidance to operators on the risks of operating PC2WE and possible mitigation measures. It is written on the assumption that an operator has achieved base-line compliance with the regulated control measures described above. This is meant as a start point to help operators integrate PC2WE risk assessments into their existing SMS risk register. Detailed risk statements, impacts, and initial and residual risk levels should be determined in line with the operator's established risk assessment processes.

Table 21: PC2WE risks & possible mitigation measures

Risks	Mitigation measures
Pilot excessive focus on PC2WE compliance results in obstacle strike	• Exposition and training briefs highlight obstacle strikes as the highest risk in helipad environments. • Obstacle avoidance techniques are prioritised above engine failure considerations and techniques, due to the relative risk levels. • The company allows variations from compliance with PC2WE considerations, in order to maintain overall safe operations, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system. • The pilot conducts a pre-departure review of the take-off path, likely obstacles, and determination of required performance to avoid obstacles in addition to PC2WE considerations.
Global fleet reliability reduces below the approved 1:100,000 engine power loss rate	• Company aircraft have historical engine failure rates of nil failures per 100,000 hours, but apply a conservative rate of 0.25 per 100,000 hours. • Annual report has been obtained from Type Certificate Holder to state compliance with 1:100,000-hour engine failure rate target. • Company SMS tracks global accidents for company aircraft to establish early trends of engine failure rates.

Risks	Mitigation measures
Pilot techniques and / or environment require exposure periods greater than the exposure time limit	• The company can justify a 36-second exposure time limit based on power loss rates. • Use of CAT A Clear Area weight limits provides sufficient power margin to remain within exposure time limits. • Exceeding 36 seconds exposure is only approved for MT or ESO operations at an MT or ESO Operating Site. • Non-MT / ESO operations are conducted to less complex landing sites than for MT / ESOs. • Pilot simulator (if available) and line training in vertical and oblique take-off and landing techniques, including awareness of the time it takes to conduct these at CAT A Clear Area weight limits. • Pilots are trained not to delay the DPATO any later than necessary, and to nominate a DPBL that is as late as possible in the approach. • Pilot training in accurate assessment of aircraft height / speed energy to allow for a safe fly-away (in simulator if available).
Pilot PC2WE performance assessment, procedures or flying techniques are inadequate or not understood	• Exposition has specific sections explaining PC2WE, what it is, and flying techniques to use. • Exposition describes pilot methods for determining obstacle gradients, and this is practiced in Line Training. • Training and checking are conducted in PC2WE techniques up to CAT A Clear Area weight limits (in simulator if available). • Co-pilot or Air Crew Member training in PC2WE requirements is provided so they can provide knowledge and procedural support for the pilot. • Variations from PC2WE are permitted, provided an in-flight risk assessment is conducted and a report is lodged into the safety reporting system.
Pilot PC2WE performance procedures or flying techniques expose third party persons or things to unacceptable impacts of rotor downwash and outwash.	• Exposition procedures for ensuring the safety of people, animals, buildings and things during helicopter operations through the establishment of downwash/outwash protection safety distances for operations. • Liaison with regular use helicopter landing site and heliport operators regarding strategies for minimising the impacts of rotor downwash/outwash at these locations. For example, downwash/outwash protection zones. • Exposition procedures for crews to have operations specific awareness training on the size and effects of rotor downwash/outwash during PC2WE and other operations. • Initial and recurrent competency and proficiency assessments to ensure flight and other crew member awareness of the effects of rotor downwash/outwash during PC2WE and other operations. • Ground crew personnel trained in rotor downwash/outwash effects and safety procedures. • Exposition procedures to ensure operational crews conduct a pre-flight and in-flight operational risk assessment of potential rotor downwash/outwash effects.

Risks	Mitigation measures
The pilot training system is incomplete or ineffective	• Company conversion training includes a specific long brief on helicopter performance and PC2WE operations. • Six-monthly training sessions are conducted, including training and checking in PC2WE operations up to CAT A Clear Area weights (in simulator if available). • Line Training provides opportunities to train pilots in the application of obstacle surveys and PC2WE requirements. • Pre-take-off and pre-landing briefings require mention to the crew of whether 'exposure' is present, or not. • Six-monthly training meetings review standardization and effectiveness of the training system.
The required engine / airframe preventative maintenance is not conducted	• Aircraft maintenance is conducted in accordance with the CASA-approved System of Maintenance. • The company follows the preventative maintenance requirements recommended and / or approved by the OEM. • Engine modifications are not conducted without approval of the engine and airframe Type Certificate holder. • The Company Quality Assurance program assesses compliance with the System of Maintenance through an audit program. • Engine and drive-train heavy maintenance is conducted by a CASA and OEM-approved overhaul facility.
Usage Monitoring System fails to record or operate correctly	• Company OMEL requires a serviceable UMS for PC2WE operations. • UMS is maintained and data assessed as accurate in accordance with the CASA-approved System of Maintenance.